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REVISIONARY STUDIES IN THE CORYNELIACEAE. II. THE GENUS CALICIOPSIS [1]

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(WITH 35 FIGURES)

5. CALICIOPSIS Peck, Ann. Rep. N. Y. State Mus. **33**: 32. 1883.
Hypsotheca Ellis & Ev., Jour. Myc. **1**: 128. 1885.
Sorica Giesenhagen, Ber. Deuts. Bot. Ges. **22**: 191. 1904.
Lagenula Arnaud, Ann. Epiphyt. **16**: 267. 1930.

Type species, *Caliciopsis pinea* Peck.

Stromata scattered to crowded, in some species commonly confluent, erumpent as rounded to somewhat elongated cushions; the protruding stromatic surface early minutely lobed; the individual lobes transformed into spermogonia, or elongating into slender columns, which are here termed ascocarps; mature spermogonium sessile to short-stipitate, apically perforate; spermatia unicellular, elongate, hyaline to slightly yellowish; ascocarps one to several to a stroma, pushing up usually among the previously formed spermogonia as relatively more prominent, tapering spines; aspect of the mature ascocarp various in the several species due largely to difference in the position in the column of the swollen portion containing the ascigerous locule; this enlargement usually more or less median, but ranging from terminal to basal; when terminal, giving the mature, ruptured ascocarp an urceolate appearance; when basal to subapical, tapering above into a more or less elongate beak through which runs a narrow, cylindrical canal; in most species a considerable section of the column existing below the enlargement as a solid stalk; ascus (p. sp.) ovoidal to ellipsoidal with a long

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delicate stalk, 8-spored; ascopores ellipsoidal to globose or subfusiform, smooth, faintly yellowish to blackish-brown, progressively more mature toward the top of the locule where they are freed by deliquescence of the ascus walls and extrude through the exit canal; apex of the immature ascigerous column pointed or blunt, at maturity perforate and dilated to narrow funnel-form as the ascospores extrude and form a rather inconspicuous, terminal, pulverulent, brown, knob-shaped mass; branching or forking of the column occasionally seen; its proliferation to form a secondary column above the primary known only in one species.

The genus differs from the others of the family in its more slender, typically stipitate ascocarp and its smaller, thinner-walled ascospores. It differs from *Corynelia* in the type of dehiscence also, and from *Corynelia, Tripospora,* and *Lagenulopsis* in that none of its species occur on *Podocarpus.* Though several members of the genus have been found in the Southern Hemisphere or in the tropics, the species occur chiefly in north temperate regions. For the most part they are parasitic on coniferous or dicotyledonous hosts.

The genus *Caliciopsis* was erected by Peck in 1880 on *C. pinea.* Though the generic name selected indicates that he noted the resemblance of the ascocarp to that of *Calicium,* he realized that the species is not a lichen. He described it as one of the stipitate Discomycetes. Five years later Ellis established the genus *Hypsotheca* on three other species, *H. subcorticalis, H. calicioides,* and *H. thujina.* He was aware of the existence of *Caliciopsis pinea* and felt that his own species are closely allied to it, but in deference to Peck's opinion that it is discomycetous he avoided incorporating it in the Pyrenomycetes. The beaked nature of the ascocarp in his own species led him to place *Hypsotheca* in the Ceratostomataceae. Later the two genera were united by Rehm [2] in the Calicieae under the name *Caliciopsis.* To von Höhnel [3] belongs the credit for first suggesting that the genus be incorporated in the Coryneliaceae.

Meanwhile, *Sorica* Giesenhagen [4] had been erected on *Capnodium maximum* Berk. & Curt., here included in *Caliciopsis.* Arnaud [5]

[2] Rab. Krypt.-Fl. 1[3]: 382. 1896.
[3] Sitz.-ber. Akad. Wiss. Wien **120**: 149. 1911.
[4] Ber. Deuts. Bot. Ges. **22**: 191. 1904.
[5] Ann. Ecole Nat. Agric. Montpellier, n. s. **12**: 23. 1912.

included the four genera, *Sorica*, *Hypsotheca*, *Caliciopsis*, and *Corynelia* in the Caliciaceae. In recognizing *Hypsotheca* as distinct from *Caliciopsis*, he states that the ascospores are globose in the former and ellipsoidal in the latter. To make this basis of separation more satisfactory he transferred *H. calicioides* to *Caliciopsis*. In the writer's taxonomic treatment of the Coryneliaceae [6] the genus *Hypsotheca* was merged with *Caliciopsis*, little emphasis being placed on difference in spore shape in the four species thus brought together. The genus *Sorica* was recognized as distinct, the extraordinary phenomenon of proliferation exhibited by the ascocarp in its single species being accorded generic significance. Ten years later Arnaud [7] followed the writer in merging *Hypsotheca* in *Caliciopsis*, and in recognizing *Sorica* as distinct, but states that proliferation of the ascocarp in *S. maxima* is not sufficiently constant to serve as the basis of generic separation. Indeed he included in the genus another species, *S. clavata*, in which the phenomenon is wholly lacking. He says that *Sorica* differs from *Caliciopsis* in having globose ascospores. He continues to regard the fructification as an apothecium, and treats the Coryneliées as a subdivision of the Caliciaceae. Our observations indicate that the phenomenon of proliferation is always present in old specimens of *S. maxima*. It is of course absent in young material. Of the species included here by us in *Caliciopsis*, *C. Symploci*, described below as new, most closely approaches *S. maxima* in morphology. Our material of this species is all young, and in none of it has proliferation been observed, though the phenomenon is perhaps present in later stages. This case emphasizes the practical difficulty involved in attempting to maintain a separation between *Sorica* and *Caliciopsis* on this one feature alone, and we are now abandoning our earlier effort to do so. We do not find it feasible, however, to follow Arnaud in basing the generic separation on difference in ascospore shape. Though the spores of *S. maxima* are typically globose and those of *C. pinea* ellipsoidal, other species exhibit variation in form between these two types. As the entire aggregation of species involved is not large and as they constitute a

[6] Mycologia **12**: 206–267. 1920.
[7] Ann. Epiphyt. **16**: 235. 1930.

coherent unit of evidently related fungi, it now seems best merely to embrace all of them in *Caliciopsis*.

The genus *Lagenula* Arnaud must be discussed in this connection. It was conceived by its author to be intermediate between *Sorica* and *Tripospora*, with globose spores and a sessile, decanter-shaped ascocarp. As erected, the genus embraced three species, *L. nigra*, *L. fructicola*, and *L. arrhiza*. The first named, designated by Arnaud as the type, had been included by him earlier in *Corynelia* as *C. juniperina*. The second had been treated by the writer as *C. fructicola*. The third was originally described as a species of *Capnodium*. Though Arnaud states that the ascocarp in *Lagenula* is wholly sessile, careful examination of material of *L. nigra* reveals that a definite stalk is sometimes present. It is to be seen in Arnaud's own drawings and is shown in our figure 18. Of greater significance, the species included in the generic concept show such great dissimilarity in spore characters that they can hardly be regarded as closely related.

In the taxonomic portion of the paper which follows, not all of the specimens examined during the investigation are listed. Brevity has been sought also by the use of capital letters in parentheses following the citations. These letters designate the institution and herbarium in which the specimens studied are to be found. The following letters have been used.

A—Herbarium Charles Peck, N. Y. State Museum, Albany, N. Y.
C—Herb. Dept. Plant Pathology, Cornell Univ., Ithaca, N. Y.
D—Herb. Charles E. Fairman, deposited at Cornell Univ.
F—the writer's personal herbarium, at Cornell Univ.
H—Farlow Herb., Harvard Univ., Cambridge, Mass.
K—Herb., Royal Botanic Gardens, Kew, England.
N—Herb. New York Botanical Garden, N. Y. City.
O—Herb. L. O. Overholts, State College, Pennsylvania.
P—Museum Nationale d'Histoire Naturelles, Paris.

KEY TO SPECIES OF CALICIOPSIS

A. Ascospores ellipsoidal to subfusiform.
  1. Ascigerous locule terminal to subterminal.
    a. Ascospores less than 7 μ in length; species occurring only on conifers.

(1) Ascigerous locule essentially terminal; the mature ruptured ascocarp having consequently an urceolate appearance; ascospores 5–6 × 3 μ.

1. *C. pinea* (FIG. 1–5)

(2) Ascigerous locule subterminal; the ruptured ascocarp retaining the definitely beaked aspect; ascospores much smaller, 4 × 2 μ.

2. *C. Pseudotsugae* (FIG. 6, 7)

b. Ascospores considerably larger, 7.5–10 × 4–5 μ; ascigerous locule terminal to subterminal; species known only on *Tilia*.

3. *C. Tiliae* (FIG. 14, 15)

2. Ascigerous locule median to submedian; ascospores 6–8 × 3.5–5 μ.

4. *C. calicioides* (FIG. 11–13)

B. Ascospores globose to ovoidal.

1. Ascospores somewhat variable in shape, typically intermediate between globose and ellipsoidal.

a. Ascocarp definitely beaked; ascospores 4–5 μ in diameter.

(1) Ascigerous locule subterminal above a long stalk.

5. *C. subcorticalis* (FIG. 8–10)

(2) Ascocarp relatively short; ascigerous locule usually basal.

6. *C. nigra* (FIG. 16–19)

b. Ascocarp not beaked, clavate to urceolate; ascigerous locule terminal; ascospores 8–10 μ in diameter.

7. *C. clavata* (FIG. 20–24)

2. Ascospores spherical or nearly so.

a. Ascospores less than 5 μ in diameter.

(1) Ascocarp short-beaked; apical proliferation not yet observed.

8. *C. thujina* (FIG. 25, 26)

(2) Ascocarp with a long beak, after dehiscence undergoing apical proliferation.

9. *C. maxima* (FIG. 27–32)

b. Ascospores 5.5–7 μ in diameter; ascocarp with a long beak and a longer stalk; apical proliferation not yet observed.

10. *C. Symploci* (FIG. 33–35)

1. CALICIOPSIS PINEA Peck, Ann. Rep. N. Y. State Mus. **33**: 32. 1880.

Calicium stenocyboides Nyl. Flora **65**: 451. 1882.

Cyphelium stenocyboides Arnold, Lichenes Monac. Exsic. *417*. 1895.

Caliciopsis stenocyboides Rehm, in Rab. Krypt.-Fl. **1**[3]: 389. 1896.

TYPE: Material in the herbarium of Peck, collected by him at Charlton, N. Y., July 1880, on *Pinus Strobus* (A); a portion de-

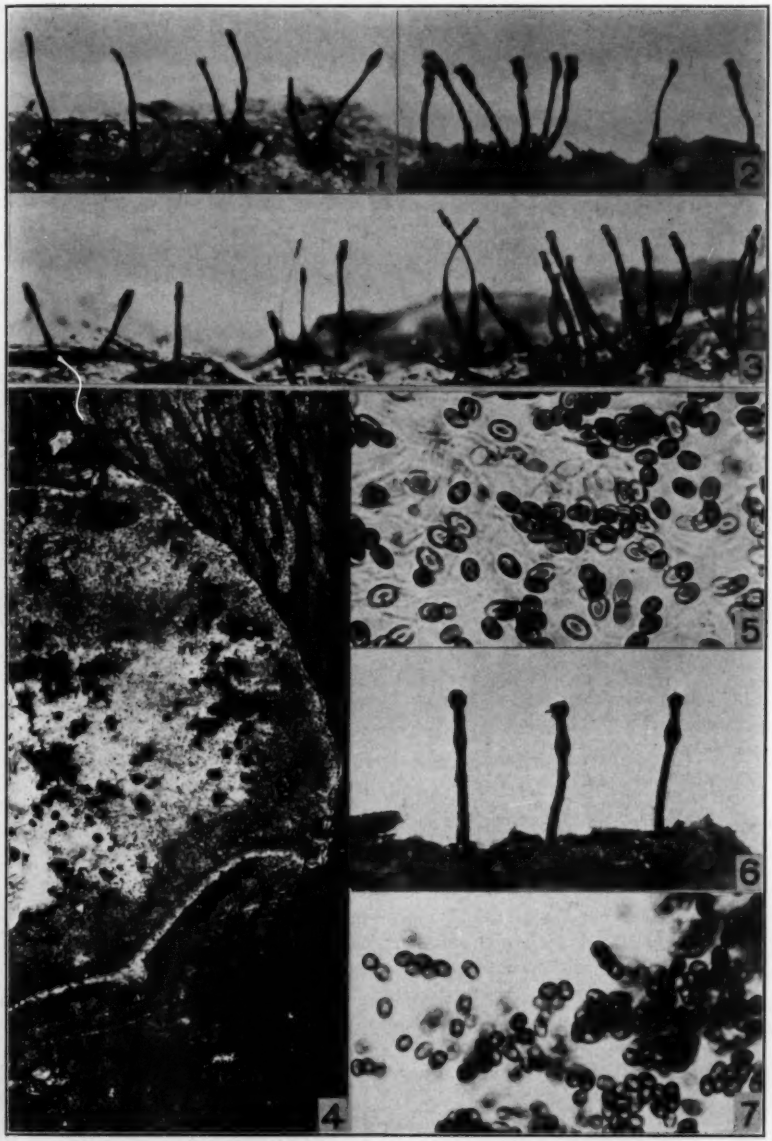
posited at the New York Botanical Garden; both examined by us (F 1688).

OTHER MATERIAL EXAMINED: Numerous collections of the species have been made by the writer near Ithaca, N. Y., on *P. Strobus* (F, C). It occurs in the eastern United States on this and various other species of pine (*P. rigida, P. pungens, P. echinata, P. virginiana*), and was found in Germany on *P. pumilo* (H). It was collected by Overholts [8] in Pennsylvania on *Tsuga canadensis* (O *11029*), and is reported by Rehm [9] from Germany on *Abies*. We have not seen Rehm's material, but the Overholts specimen agrees with the fungus on pine. Material on the various species of pine is indistinguishable.

Stromata initiated beneath the surface of the bark as small, more or less circular, often confluent, flat cushions, erumpent, bearing over the protruding surface a crowded group of minute, hemispherical to subpyriform lobes which develop into spermogonia and ascocarps; the former maturing first and commonly covering the stroma as a densely crowded cluster; spermogonium globose to ovoidal, apically perforate; spermatia rod-like to allantoid, hyaline to pale yellowish, 2.5–3.5 μ in length, borne on conical to bottle-shaped spermatiophores; a relatively smaller number of stromatic lobes pushing out among the spermogonia and projecting far above them in a loose fascicle as spine-like, cylindrical, ascigerous columns; apex of column finally enlarging into an elongate, fusiform swelling within which an ascigerous locule differentiates; mature column often somewhat curved or flexuous, averaging 1.5 mm. in length, occasionally branched or forked; ascigerous swelling 125–175 μ in lateral diam., essentially terminal, with little or no beak, when dry often laterally collapsed, in dehiscence the accumulation of a fuzzy, brownish plug of extruding spores giving an urceolate form and a striking resemblance to the capsule in such mosses as *Hypnum;* column below swelling constituting a long, slender, cylin-

[8] Mycologia **22**: 235. 1930.
[9] Rab. Krypt.-Fl. **1**[3]: 382. 1896.

FIGS. 1–5. *Caliciopsis pinea.* 1, immature unruptured ascocarps, × 11. 2, 3, mature ascocarps, × 11. 4, clearly outlined, depressed canker on bark of *Pinus strobus,* showing scattered, erumpent, black stromata; surface of canker somewhat overrun by a thin layer of resin, × 3. 5, asci and mature ascospores, × 730. FIGS. 6, 7. *C. Pseudotsugae.* 6, lateral view of three ascocarps, each borne on a separate stroma emergent from the bark of *Pseudotsuga taxifolia,* × 11. 7, asci and mature ascospores, × 730.



FIGS. 1–7.

drical, solid stalk, 100–125 μ in diam., usually broadened somewhat toward the base; ascus (p. sp.) ellipsoidal, $20 \times 8\,\mu$; ascospores chiefly ellipsoidal, $5–6 \times 3\,\mu$.

In labeling plate 18 of our earlier paper [10] the numerals 48 and 49 were unfortunately interchanged, leaving the impression that the spores of *C. pinea* are spherical and those of *Sorica maxima* elongate, when the reverse is true. Though field observations indicate that *C. pinea* is parasitic on the various trees on which it occurs, proof based on inoculations [11] is available only in the case of *Pinus Strobus*. On this host definite cankers are formed on the trunk and larger branches, and attacked saplings are apparently sometimes killed.

2. **Caliciopsis Pseudotsugae** sp. nov.

TYPE: Collected by J. R. Hansbrough (No. *185*) at Daisy Lake, British Columbia, June 22, 1930 (F *2044*). Other specimens collected by him in British Columbia and Oregon have been found to be the same. The material was identified tentatively by the writer as *C. pinea* Peck and in consequence was mentioned under that name by J. S. Boyce.[12]

Columna stromatica *C. pinea* similis visui obvia, verum maior et typi magis solitarii; maxima 2 mm. est; stilus diametri 250 μ est; loculus subapicis; columnae summa pars in rostrum exile exit, non urceolata; ascospori ad ellipsis formam accedunt, fere $4 \times 2\,\mu$.

Stromata occurring on the twigs and small branches of Douglas fir, *Pseudotsuga taxifolia* (Lam.) Britton, usually in definite association with small, oval to ellipsoidal, sharply delimited cankers, initiated as small, scattered cushions in or just beneath the bark, chiefly in or bordering the callus at the margin of the canker; each stroma giving rise to one to several small spermogonia and usually to only a single ascocarp; the latter protruding as an isolated, rigid, black spine which elongates into a slender, straight to flexuous, cylindrical column; column attaining a length of 2 mm., tapering to a somewhat broadened base, and provided with a prominent, ovoid to fusiform, subterminal, ascigerous enlargement, which has a maximum lateral diameter of approximately 250 μ and in dried specimens is usually laterally collapsed; portion of column above

[10] Mycologia **12**: 206–267. 1920.
[11] Mycologia **28**: 201. 1936.
[12] Forest Pathology. p. 267. 1938. McGraw-Hill Book Co.

enlargement tapering toward the apex to form a definite beak, that below constituting a long stalk, 150 μ in diam.; the extruding mass of ascospores in dehiscence forming a pulverulent, brown plug often exceeding 250 μ in diameter; asci (p. sp.) approximately 14×7 μ; ascospores ellipsoidal, 4×2 μ.

Though this species resembles *C. pinea* in gross aspect and in its occurrence on a coniferous host, there are several points of pronounced difference. The stromatic column is larger in all its dimensions, and more typically solitary. The ascigerous locule is subapical, giving the tip of the column a beaked rather than an urceolate aspect. The ascospores are much smaller than in the type species. The writer has not seen the fungus in nature. Its association with definite cankers suggests a parasitic relationship. Though Hansbrough feels that the cankers may have been initiated by cicada injury, he states that the fungus is apparently parasitic on suppressed trees.

3. CALICIOPSIS TILIAE Arnaud, Ann. Epiphyt. **16**: 262. 1930.
Caliciopsis Ellisii Sacc. var. *Tiliae* Arnaud, Ann. Ecole Nat. Agric. Montpellier, n.s. **12**: 33. 1912.

TYPE: Arnaud states that his collections of this species were made from 1907 to 1913 at the Ecole Nationale d'Agriculture de Montpellier, in Hérault, France, all the material being taken from a canker on the trunk of a single tree of *Tilia sylvestris*. The two specimens cited by him were collected Feb. 18, 1907, and Sept. 17, 1913. A portion of the first of these, which presumably may be designated as the *type*, as well as material of a third collection made May 23, 1911, were very kindly sent to us by Arnaud, and have served as the basis for our studies (P).

Stromata initiated deep in the crevices of the bark, and erumpent there as minute, scattered cushions, each developing a small cluster of spermogonia and later one to several elongating ascocarps; spermogonium typically more slender than in other species, subfusoid, $125–200 \times 300$ μ, tapering above into a short beak and below into a more or less definite stalk; spermatia hyaline, allantoid, 3×0.5 μ; ascocarps pushing out through the crevices of the bark, as in *C. subcorticalis*, not protruding appreciably beyond its surface, visible in the crevices as erect, black spines, exceptionally variable both in length and lateral diameter, in some instances as

long as 2 mm., in others mature at less than half that extent, not infrequently having a forked tip or bearing short lateral branches; ascigerous locule subterminal to terminal; the apex in the latter case urceolate at maturity and very similar to that of *C. pinea;* ascospores ellipsoidal to subfusiform, yellowish-brown, 7.5–10 × 4–5 μ, relatively large, exceeded in size in the known species of the genus only by those of *C. clavata.*

In spore characters the species resembles *C. calicioides,* but in the form of the ascocarp more closely approaches *C. subcorticalis.* The three species are known from so few collections that discovery of intergradation between them would not be wholly unexpected.

4. CALICIOPSIS CALICIOIDES (Ellis & Ev.) Fitzp. Mycologia **12**: 220. 1920.

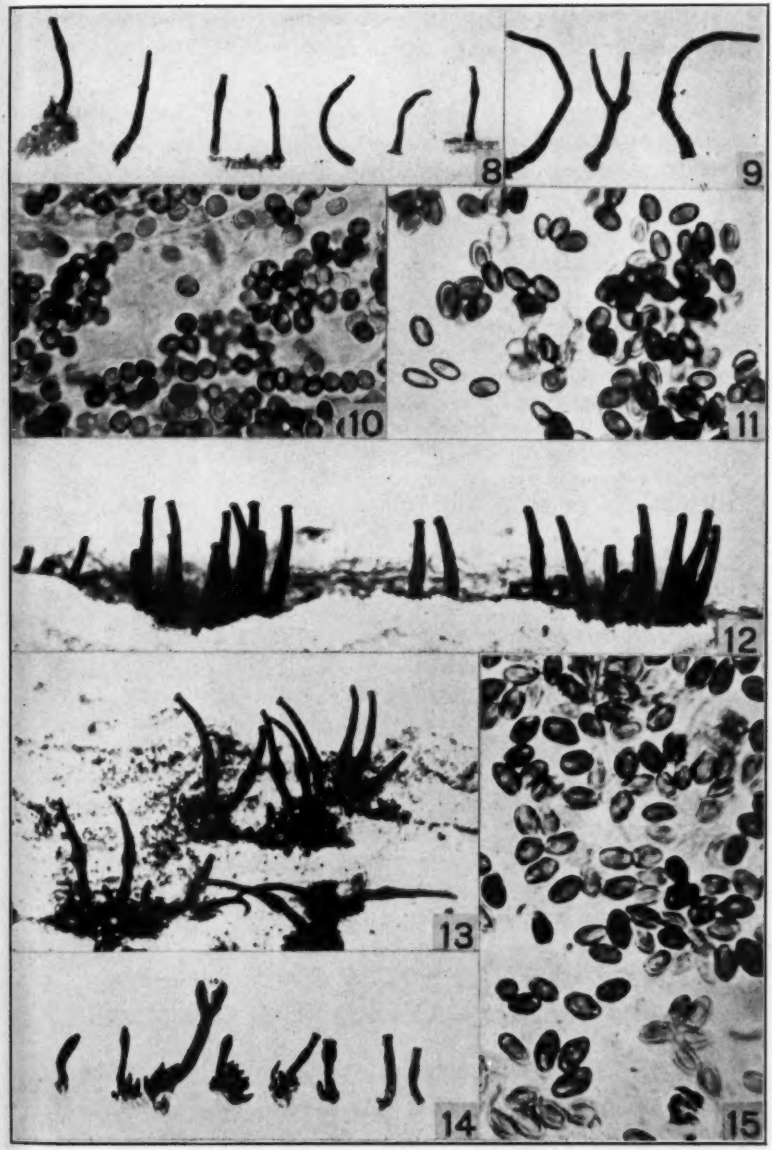
Hypsotheca calicioides Ellis & Ev. Jour. Myc. **1**: 129. 1885.
Caliciopsis Ellisii Sacc. Syll. Fung. **8**: 833. 1889.

TYPE: A specimen in the herbarium of Ellis (N), labeled *Hypsotheca calicioides* E. & E., collected by Suksdorf (No. *256*) in Washington Territory and sent to Ellis, Dec. 1883, by C. G. Sprague (F *1720*). The original description of the species in the handwriting of Ellis is attached to this material and was clearly based on it.

OTHER MATERIAL EXAMINED: Ravenel, Fung. Carol. Exs. Fasc. 1. No. *83* (H, N); Overholts herbarium, No. *12079,* col. E. H. Moss (No. *2114*), Aug. *7*, 1929, at Villeneuve, Alberta, on *Populus balsamifera* (F *2046*); Ellis herbarium, No. *71* labeled *"Hypsotheca calicioides* (Fr.) var. *caespitosa* n. var.," col. March 1891 on decaying poplar log, at Lake Pend d'Oreille, Idaho (N, F *1719*). We have provided photographs of the four [13] known collections to

[13] See also figures 35, 36 in the writer's earlier paper.

FIGS. 8–10. *Caliciopsis subcorticalis.* 8, 9, ascocarps removed from the bark, and arranged to show variation in size and shape, × 11. 10, mature ascospores, × 730. FIGS. 11–13. *C. calicioides.* 11, mature ascospores, × 730. 12, ascocarps emergent from crevices in the bark, ex. Rav. Fung. Carol., × 11. 13, erumpent stromata bearing spermogonia and ascocarps, ex. Herb. Overholts, × 11. FIGS. 14, 15. *C. Tiliae.* 14, ascocarps and spermogonia removed from the bark and arranged to show variation in size and shape, × 11. 15, mature ascospores, × 730.



FIGS. 8–15.

illustrate the variation in form of the ascocarp. The small number of specimens renders minor differences especially noticeable.

Stromata erumpent on bark of poplar, scattered or lying in concentric circles, occasionally confluent; the protruding surface covered with crowded spermogonia among which later a smaller number of ascocarps push out and elongate as black spines; spermogonium sessile to slightly stipitate, slender, approximately 150 μ in lateral diameter, apically minutely umbilicate becoming perforate; spermatia slightly elongate, 2.5–3 μ in length, hyaline, in mass yellowish; ascocarp reaching 2 mm. in length, composed of a stalk, a median or submedian enlargement containing the ascigerous locule, and a prominent beak; stalk 100–170 μ in diameter, cylindrical, of varying length, somewhat broadened toward the base; ascigerous enlargement 200–340 μ in median lateral diameter, tapering above and below to a total length of 270–500 μ, sometimes collapsing laterally on drying; beak narrower than the stalk, with an average diameter of 75–125 μ and a length approximately twice that of the ascigerous swelling, straight and rigid to slightly curved, tapering uniformly toward the apex, which in early stages is pointed and sometimes minutely umbilicate; terminal mass of extruded ascospores characteristically flattened; ascospores ellipsoidal to subfusiform, 6–8 $\times$ 3.5–5 μ, yellowish to light brown.

5. CALICIOPSIS SUBCORTICALIS (Cooke & Ellis) Fitzp. Mycologia **12**: 223. 1920.

Sphaeronema subcorticale Cooke & Ellis, Grevillea **6**: 83. 1878.
Calicium ephemerum Zwackh, Lichenen Heidelbergs p. 81. 1883.
Hypsotheca subcorticalis Ellis & Ev. Jour. Myc. **1**: 129. 1885.
Hypsotheca ephemera Sacc. Syll. Fung. **10**: 72. 1891.
Caliciopsis ephemera Rehm, Rab. Krypt.-Fl. 1^3: 388. 1896.

TYPE: Fungi of New Jersey, No. *2743,* in herbarium of M. C. Cooke (K), this being the original collection of *Sphaeronema subcorticale* Cooke & Ellis made by Ellis at Newfield, N. J., Sept. 16, 1877, on loosened bark on decaying limbs of oak lying on the ground; *co-type* material in herbarium of Ellis (N).

OTHER MATERIAL EXAMINED: A collection made by Ellis at Newfield, March 1883, on oak bark (N); another made by him in the same locality, April 1888, and distributed as Ellis & Ev. N. Am. Fungi *2123,* which shows the fungus on bark of *Quercus coccinea,* especially on the surface of old galls believed by him to have been

caused by *Dichaena strumosa* (N, H); a third collection made at Wilmington, Delaware, by A. Commons (No. *1154*), Dec. 1889, and labeled by him as collected "in crevices bark *Acer rubrum* L." The bark of this Delaware material is so badly decayed that our efforts to prove it to be *Quercus* have been unsuccessful. We have not seen a European collection of the species, and have not been able to verify the statement of Rehm that *Calicium ephemerum* Zwackh is identical. As the parasitic nature of the species and its host range are both in doubt, it is especially desirable that more material be collected. We have not seen the fungus in the fresh condition, and in no other species of the genus is our knowledge based on such fragmentary specimens.

Stroma usually hidden deep in the crevices of the bark and erumpent there, bearing a few spermogonia and one or two elongating ascigerous columns; the latter more variable in size and form than in other species, often curved or flexuous, not infrequently forked or bearing lateral branches, sometimes winding for a considerable distance through the crevices of the bark to reach the surface; the tips of the columns visible in the crevices at maturity and appearing as erect, black spines; columns exceptionally variable in lateral diameter, sometimes attaining 3 mm. in length, usually shorter, typically broadened at the base and tapering upward to a narrowed tip; ascigerous enlargement subterminal, surmounted by a definite beak; the enlargement 200–325 μ long, reaching 150 μ in lateral diameter, often little broader than the column below, sometimes laterally collapsed, asci (p. sp.) 12–15 $\times$ 7–9 μ; ascospores broadly ovoidal to globose, 4–5 μ in diam.; spermogonium approx. 100 μ in diam., apically perforate; spermatia 2.5–3.5 μ in length.

6. **Caliciopsis nigra** (Schrader ex Fries) comb. nov.

Stilbum nigrum Schrader, in Schleicher, Plantae Cryptogamicae Helveticae, No. 99, 1805; listed in Schleicher, Catalogus Plantarum, 3d. edit., p. 46, 1815, and 4th edit., p. 59, 1821; described in de Lamarck & De Candolle, Flore Francaise, 3d. edit. **2**: 593. 1805; Fries, Syst. Myc. **3**: 302, 342. 1832; not *Stilbum nigrum* Berk., in Hooker, Engl. Flora **5**: 330. 1837.

Ceratostoma juniperinum Ellis & Ev. Proc. Acad. Nat. Sci. Philadelphia, p. 226. 1890.

Ceratostoma stromaticum Delacroix, Bull. Soc. Myc. France **7**: 105. 1891.

Corynelia juniperina Arnaud, in Hariot, Bull. Soc. Path. Vég. France **2**: 8. 1915.

Lagenula nigra Arnaud, Ann. Epiphyt. **16**: 267. 1930.

TYPE: Schleicher, Plantae Cryptogamicae Helveticae No. *99*, type of *Stilbum nigrum* Schrader (K), was examined by the writer and found to be the same as *Ceratostoma juniperinum* Ellis & Ev. and *C. stromaticum* Delacroix. This original collection was made in Switzerland on *Juniperus communis*. The writer is under obligation to Mr. E. W. Mason, who found the specimen in the herbarium at Kew and made it available for examination.

OTHER MATERIAL EXAMINED: *type* of *Ceratostoma juniperinum* Ellis & Ev., in Ellis herbarium (N), col., Jan. 1889, by Rev. J. L. Zabriski, on *Juniperus virginiana*, on Long Island near New York City; D. Saccardo, Mycotheca Italica, No. *1297*, col. autumn 1902, by P. Bacarini, at Fiesoli, Italy (N); specimen labeled *Ceratostoma stromaticum* Delacroix, col. Apr. 1892, by Delacroix, on *J. Sabinae*, at Fontainbleu, France (H); Jaap, Fungi Sel. Exsic. No. *682*, col. O. Jaap, on *J. phoenicea*, Dalmatia, Yugoslavia (C); specimen col. on *J. procera*, Nairobi, Kenya, West Africa, com. H. Wilkinson (K).

Stromata formed in the outer bark, erumpent chiefly in its crevices; ascocarps standing in these as crowded, black, blunt-tipped spines, relatively small as compared with those of other species of the genus, and more characteristically sessile; ascigerous enlargement usually basal in the column, or nearly so, but occasionally submedian (FIG. 18), considerably longer than wide, 280–350 × 170–240 μ, at maturity often laterally collapsed, tapering above into a cylindrical beak, 100–125 μ in diam.; apex of beak bearing at maturity a rather broad, flat mass of extruded ascospores, and after dissemination of the spores appearing as a flattened funnel; the entire ascocarp shaped like a tiny decanter, as stressed by Arnaud in his characterization of the genus *Lagenula;* ascospores light brown to blackish brown, globose to ovoidal, 4–5 μ in diam., not uncommonly flattened or irregular.

This species is known to have been collected in eastern North America, East Africa, and various countries of Europe on the

bark of species of *Juniperus,* and is confined apparently to more or less definite galls. Whether it stimulates the formation of these has not been determined. The writer has not seen the species in nature. An organism reported by Neger [14] on similar galls on *Cupressus sempervirens* is perhaps the same. The galls on juniper are thought by Cavara [15] to be caused by a bacterial parasite, the *Caliciopsis* being regarded as secondary, but some other observers have disagreed with him.

The binomial, *Stilbum nigrum* Schrader, was first used by Schleicher on an herbarium label unaccompanied by descriptive matter. Though later he twice listed the name in publication, the first description was provided by De Candolle. Fries mentioned the species in Systema Mycologicum as *S. nigrum* and cited the De Candolle description. Though he did not describe the fungus, he understood its real nature, stating it to be near or identical with *Sporocybe calicioides,* now embraced in *Caliciopsis.* Effective publication of the specific name, under modern rules of nomenclature, dates from the action of Fries in attributing the species to Schrader, and in citing the description of De Candolle. Later Arnaud designated the species as the type of his new genus *Lagenula.*

7. **Caliciopsis clavata** (Lév.) comb. nov.

Sphaeronema clavatum Lév. Ann. Sci. Nat. III. **5**: 257–280. 1846.

Aposphaeria clavata Jaczewski, Nouv. Mem. Soc. Imp. Nat. Moscou **15**: 353. 1898.

Corynelia clavata Mont. *in herb.* Mus. Nat. Hist. Natur. Paris; not *C. clavata* (L.) Sacc., in Pirotta, Nuovo Giorn. Bot. Ital. **21**: 313. 1889.

Sorica clavata Arnaud, Ann. Epiphyt. **16**: 265–267. 1930.

TYPE: Collection made by Cl. Gay in Chili (Herbier du Chili austral envoyé par M. Gay: 3e envoi) on leaves and twigs of *Drymis chilensis* DC., deposited chiefly in the herbarium of G. Montagne (P). The species is known only from the original collection.

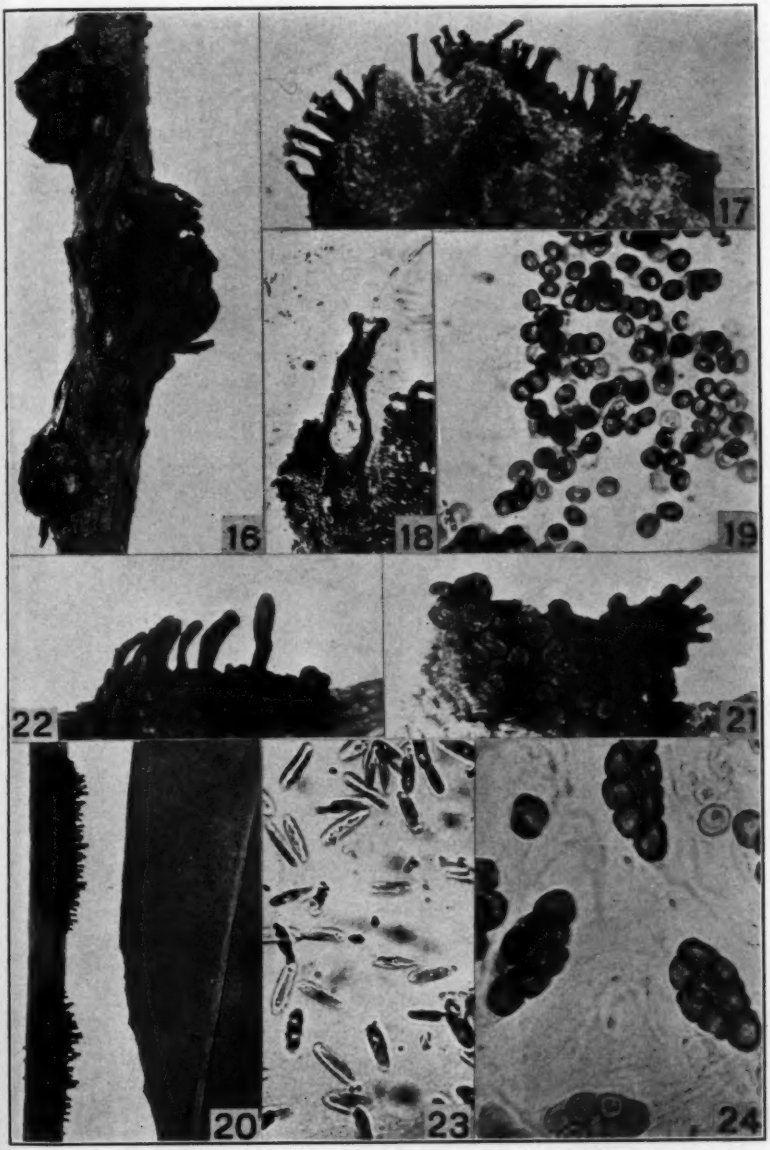
[14] Myc. Centralb. **2**: 129. 1913.

[15] Bul. Soc. Bot. Ital. No. 8. 241. 1898.

Stroma erumpent through the ruptured epidermis of leaves and twigs, or emergent along the margin of wounds, bearing over the exposed surface in early stages a crowded group of spermogonia, among which cylindrical columns later protrude and elongate into considerably more prominent, clavate ascocarps; spermogonium 250–400 μ in diam., usually stout, turbinate, and short-stipitate, with a minute, apical, perforate papilla; stalk of spermogonium sometimes abnormally elongated while the enlargement containing the spermatial cavity is of correspondingly reduced diameter, a slender clavate body resembling an immature ascocarp resulting (FIG. 21, upper right); ascocarp reaching a length of 800–1100 μ and a diameter of 275 μ, clavate until maturity, then with dehiscence assuming terminally an urceolate aspect; the tip finally with a flattened, brownish, pulverulent mass of extruding spores; ascospores subglobose to globose, brown, 8–10 μ in diam., larger than in any other known species.

Léveille, the first investigator to publish on the species, confused the slender, clavate, immature ascocarps with the abnormally long-stipitate spermogonia mentioned above. He considered both to be the beaks of pycnidia and described the fungus as *Sphaeronema clavatum* Lév. Later, Montagne discovered that some of the clavate structures contain asci, and labeled them *Corynelia clavata* Montagne. He did not publish this binomial and his use of it was probably unknown to Saccardo, who later applied it to a wholly different fungus on *Podocarpus*. Finally, Jaczewski found that fructifications of two sorts are present. Regarding the spermogonia as pycnidia, and noting that they are not beaked, he used the name *Aposphaeria clavata* Jaczewski to replace *Sphaeronema clavatum* Lév. For the ascocarp he suggested the name *Caliciopsis clavata,* but did not actually use the binomial. His statement that the apex of the ascocarp ruptures by a definite cleft is now known to be erroneous.

FIGS. 16–19. *Caliciopsis nigra.* 16, galls on *Juniperus* bearing numerous ascocarps, especially in the crevices, × 2. 17, portion of gall cut away to show the crowded ascocarps, × 16. 18, a single ascocarp in longitudinal section showing a definite stalk, × 50. 19, mature ascospores, × 730. FIGS. 20–24. *C. clavata.* 20, crowded fruit-bodies, visible here only on the twig, but occurring on the leaf also, × 2. 21, cluster of spermogonia, mostly short and turbinate, but four abnormal individuals at the upper right corner with long stalks and slightly swollen apices, × 11. 22, clavate ascocarps of various ages arising among spermogonia, × 11. 23, spermatia, × 730. 24, asci with nearly mature ascospores, × 730.



FIGS. 16–24.

8. CALICIOPSIS THUJINA (Ellis & Ev.) Mycologia **12**: 265. 1920.
Hypsotheca thujina Ellis & Ev. Jour. Myc. **1**: 128. 1885.

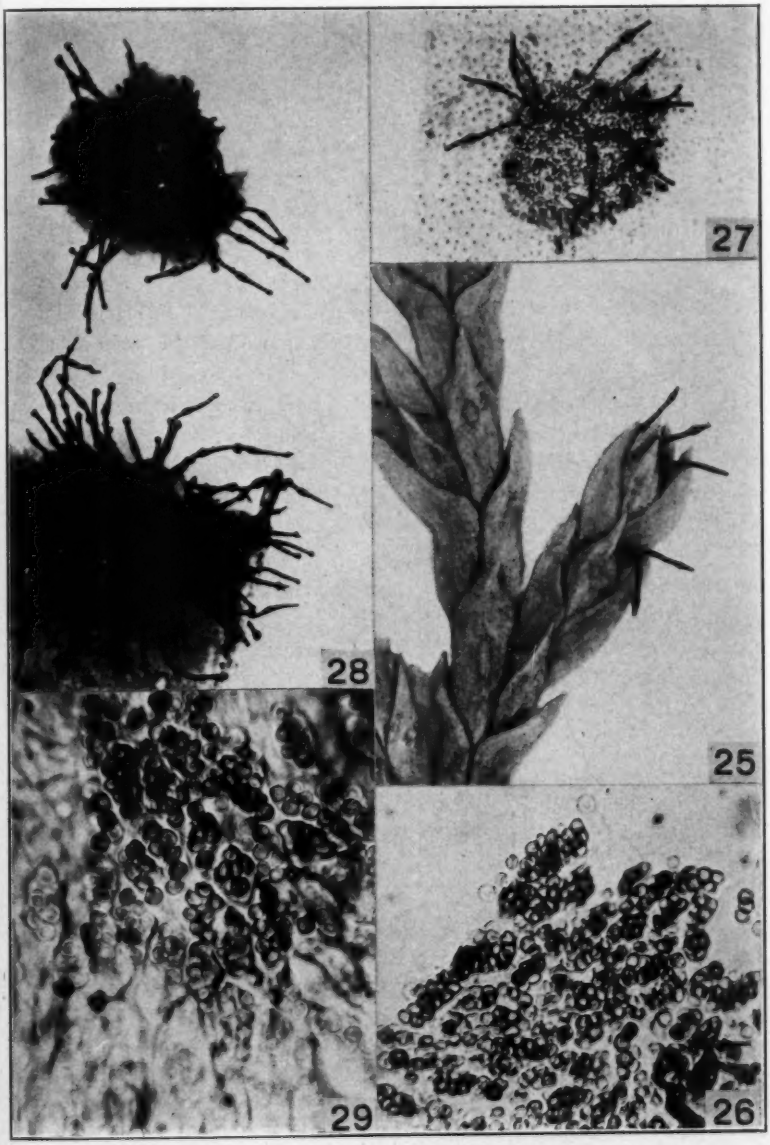
TYPE: Specimen collected by J. B. Ellis (No. *1033*) at Newfield, New Jersey, April 1880, on dying foliage of *Chamaecyparis thyoides* (N).

Ascocarps usually standing singly, occasionally in pairs, often accompanied at their bases by one to several spermogonia; spermogonium 200–230 × 150–170 μ, apically perforate; spermatia hyaline, rod-like, straight or curved, 2.5–3.5 × 0.75 μ; ascocarp reaching a total length of 1 mm., consisting of a long stalk, a subapical enlargement containing the ascigerous cavity, and a terminal beak; enlargement ellipsoidal, 150–175 μ long, reaching 110 μ in diam., collapsed and flattened when dry; stalk cylindrical, straight or curved, 600–750 μ in length, 60–75 μ in diam., slightly broadened at the base; beak reaching 110 μ in length, of approximately the same diameter as the stalk, but tapering toward the tip; apex marked by an umbilicus which in dehiscence becomes a narrow funnel-shaped perforation through which the ascospores extrude forming a small, brown pulverulent knob; ascus (p. sp.) 12–14 × 5–6 μ; ascospores globose to subglobose, light brown, 3–3.5 μ in diam.

When the writer published his earlier treatment of the genus, he listed this species as doubtful. It had not then been possible to locate the type specimen in the herbarium of Ellis. As it seemed likely that it had been merely improperly filed, repeated search was made for it at the New York Botanical Garden over a period of fifteen years. Finally, in June 1934, it was discovered, accompanied by a detailed diagnosis in the handwriting of Ellis. The material is in good condition and embraces about forty ascocarps in various stages of development. The foregoing description and accompanying photographs were made from it.

9. CALICIOPSIS MAXIMA (Berk. & Curt.) Höhnel, Sitz.-ber. Akad. Wiss. Wien **128**: 84. 1919.

FIGS. 25, 26. *Caliciopsis thujina*. 25, ascocarps arising from the imbricated leaves of *Chamaecyparis*, × 11. 26, asci with mature ascospores, × 730. FIGS. 27–29. *C. maxima*. 27, the primary series of unproliferated ascocarps protruding among the sporangia of the fruit-dot of *Polypodium*, × 11. 28, older material showing linear series of ascocarps resulting from repeated proliferation, × 11. 29, asci and mature ascospores, × 730.



FIGS. 25–29.

Capnodium maximum Berk. & Curt. Jour. Linn. Soc. **10**: 391. 1869.

Sorica Dusenii Giesenhagen, Ber. Deuts. Bot. Ges. **22**: 191. 1904.

Sorica maxima Giesenhagen, Ber. Deuts. Bot. Ges. **22**: 355. 1904.

Capnodiella maxima Sacc. Syll. Fung. **17**: 621. 1905.

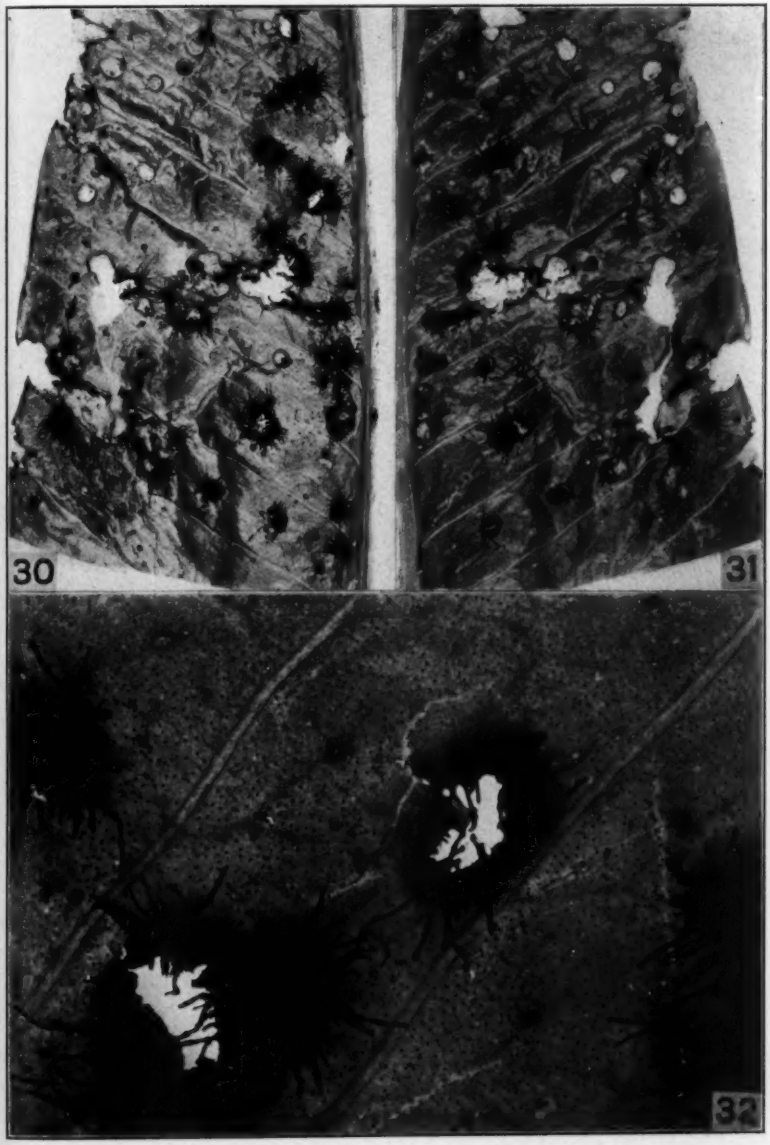
Corynelia pteridicola Stevens, Illinois Acad. Sci. Trans. **10**: 179. 1917.

TYPE: No. *786* in herbarium of Berkeley (K). Collected in Cuba by Wright on *Polypodium*. Examined by the writer (F *1641*).

OTHER MATERIAL EXAMINED: Fungi Cubenses Wrightiani No. *816* in Curtis herbarium (H) *co-type;* Porto Rican Fungi No. *3551,* at University of Illinois, *type* of *Corynelia pteridicola,* col., Oct. 12, 1913, at Anasco, Porto Rico (F *1562*); specimen No. *1021a,* in herbarium Agric. Exp. Sta., Rio Piedras, Porto Rico, col. J. R. Johnston, Apr. 7, 1913, at La Romano, Dominican Republic (F *1528,* C *12058*); specimen col. by Sodiro, at Puente de Chimbo, Ecuador, deposited in Patouillard Herbarium (H, F *1640*); Rehm Ascomyceten No. *1817,* material col., Jan. 1909, by S. J. Rick at Theresiopolis, Serra Geral, Brazil (N, D, F *1638*).

Mycelium parasitic in the fronds of ferns; stromata in some collections limited to the fruit-dots (sori of sporangia), showing no tendency to form in surrounding tissues, and ordinarily not even associated with discoloration of the opposite surface of the frond; in other collections occurring elsewhere in the frond only; when formed in the fruit-dot, hidden from view beneath the host sporangia, their presence unsuspected until the black, bristle-like columnar, ascigerous lobes push up and protrude; when developed elsewhere, visible early as minute, erumpent cushions, which increase in diameter and thickness after emergence and tend to become erumpent on the opposite leaf surface also; in older material, in many cases, found bordering definite holes and having in consequence a more or less completely annular form; ascigerous column,

FIGS. 30–32. *Caliciopsis maxima.* 30, upper surface of leaf of *Polypodium phyllitidis* showing perforations bordered by annular stromata bearing radiating, proliferating ascocarps, × 2½. 31, lower surface of same leaf. 32, portion of same leaf, × 11.



FIGS. 30–32.

long-stalked, prominently beaked, differing from that of all other known species in its tendency to undergo repeated apical proliferation, *i.e.* after dehiscence of the tip of the primary column and escape of the ascospores from its ascigerous enlargement, a second column formed by renewed growth of the hyphae at the margin of the funnel-shaped apex of the first, and in turn a third from the tip of the second, the process continuing until as many as five ascigerous locules have matured successively in linear series; less commonly a forked condition seen which results from proliferation of two columns from a single apex; the primary column usually longest, sometimes 1500 μ in length; those formed later often not exceeding half that maximum; stalk long, slender, flexuous, 35–50 μ thick, sometimes hairy with brown hyphae; enlargement containing the ascigerous locule ellipsoidal, 125–150 μ in width and approximately 250 μ in length, tapering equally above and below; beak, 200–350 μ in length, in dehiscence apically perforate, forming a reddish-brown, pulverulent, terminal knob; asci (p. sp.) 15–17 $\times$ 10 μ; ascospores typically globose, in some cases subglobose, possibly from shrinkage or mutual pressure, never definitely ellipsoidal, yellowish-brown, 3–4 μ in diameter; spermogonium sessile to short-stipitate, subglobose, papillate, often clothed in brown, hair-like hyphae; spermatia hyaline, unicellular, narrow-fusiform, 11–24 $\times$ 4 μ.

Parasitic on *Polypodium* (*Campyloneurum*) *crassifolium, P. phyllitidis, P. punctatum, P. Schomburghianum,* and probably other species. Known from Cuba, Porto Rico, San Domingo, Ecuador, Venezuela, and Brazil.

Material from seven collections of the species has been studied by the writer. In five of these the stromata occur exclusively in the sori. In the other two they are scattered over the leaf surface, sori being in fact absent. Though the general aspect of the fungus on the host in the two cases is thus dissimilar there is no correlated morphological difference to warrant recognition of two species. It may be of interest to record that in the type specimen of *Capnodium maximum* Berk. & Curt. the stromata are in the sori, while in the original specimens of *Corynelia pteridicola* Stevens they are not. Giesenhagen, who saw material of both sorts, suggests that occurrence of the fungus in the sori is common because the cell walls of that structure in the embryonic condition are thin and permit easy penetration, while the cuticle covering the epi-

dermal cells offers greater resistance. He states further that the stromata, formed outside the sori, border wounds caused by biting insects. Field observations led Stevens to believe that the holes in the leaf are due to the action of the fungus itself, not to insect injury. Though only herbarium material has been available to the writer, there seems to be evidence in it in support of the latter viewpoint.

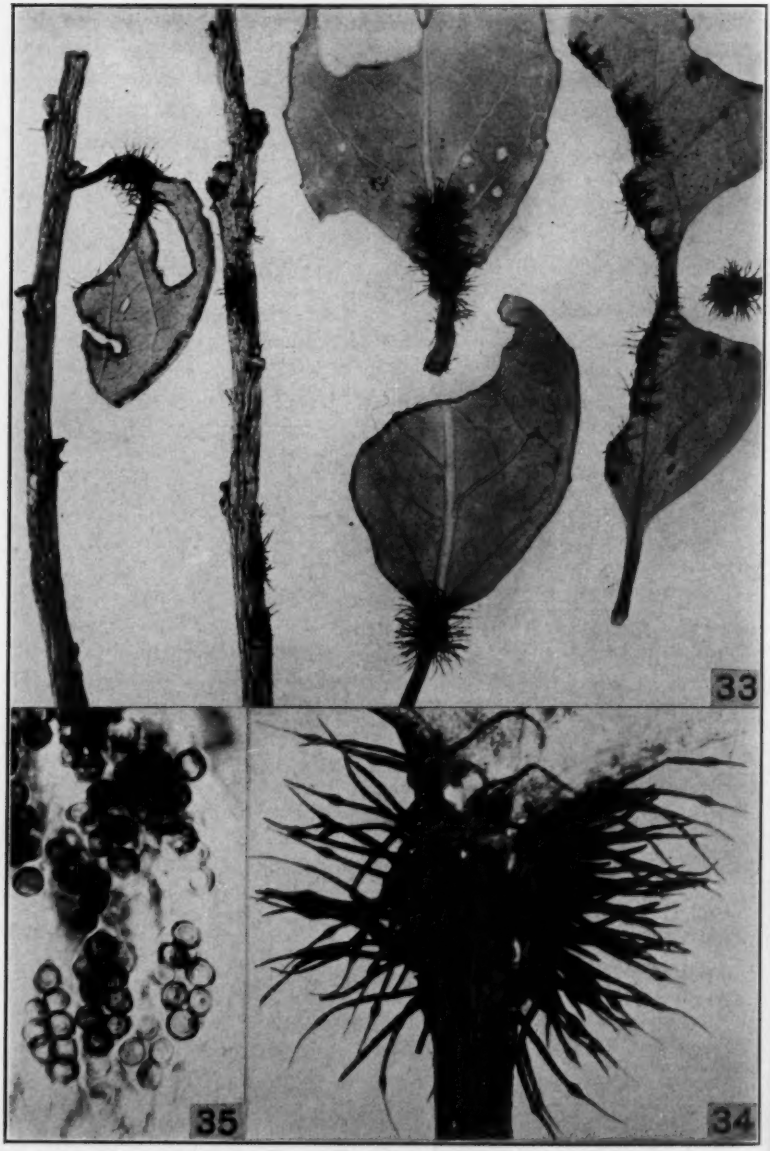
10. **Caliciopsis Symploci** sp. nov.

TYPE: Material collected by T. Petch at Sita Eliya, Ceylon, April 1923, on *Symplocos obtusa* Wall., a dicotyledonous tree with glabrous, leathery leaves (F *2029*). Another collection of somewhat younger material, taken from the same tree by Petch in March 1922 (F *2013*), was also studied. Expression of appreciation is due the collector for placing the material at our disposal.

Columna stromatica magna et flexuosa; maximae sunt 2.75 mm.; constant e stilo tenui cuius diametrus est 100 μ fere, parte latiore plana et nonnunquam collapsa, ascigera (275 × 150 μ) et rostro magno et in aciem exeuente; ascospori sphaerici vel subsphaerici, brunneolis, diametri 5.5–7 μ.

Mycelium parasitic in the leaves and young twigs; leaves markedly injured, as if by chewing insects; stromata formed on both leaves and twigs; on the leaf located chiefly along the petiole and midrib and at the margin of the blade rather than scattered over its surface, more rarely annular around a perforation as in the preceding species; the stromatic base giving rise to a few, inconspicuous, sessile spermogonia and a prominent, dense mass of extremely long, radiating, ascigerous columns; all of the latter thus far observed, relatively young, only a few dehiscent, and none observed undergoing proliferation; column at maturity often somewhat curved, reaching 2.75 mm. in length, composed of a long, slender stalk, approximately 100 μ in diam., a flattened, often collapsed enlargement containing the ascigerous locule, and a tapering, pointed beak about half the length of the stalk; ascigerous enlargement attaining a length of 275 μ and a width of 150 μ; ascus (p. sp.) clavate to saccate, 22 × 12 μ; ascospores spherical or nearly so, 5.5–7 μ in diam., light brown.

This species in the character of its spores and in its gross aspect on the host gives indication of being more closely related to *C.*



FIGS. 33–35.

maxima than any other. It is larger in its various measurements, however, and is parasitic on a host plant remote from the ferns. Had its ascigerous columns revealed proliferation comparable to that in *C. maxima,* the genus *Sorica* would perhaps have been retained for these two species.

DOUBTFUL SPECIES

CAPNODIUM ARRHIZUM Pat. & Gaill. Bull. Soc. Myc. Fr. **4**: 105. 1888.

Lagenula arrhiza Arnaud, Ann. Epiphyt. **16**: 269. *Pl. 7, figs. A–E.* 1930.

TYPE: Champignons du Haut-Orénoque recullis en 1887 par A. Gaillard, No. *260.* Found at San Fernando de Atabaya, Venezuela, on coriaceous, fallen leaves of an unidentified, probably dicotyledonous plant. Material deposited in the herbarium of the National Museum of Natural History in Paris. The species is known only from the type collection.

Stroma rupturing and shredding the leaf surface and causing the formation there of a prominent, pulvinate excresence; ascocarps emergent individually from the shredded covering layer and undergoing elongation without exposure of the stromatic base buried in the host, tending to radiate as if from a common center and at maturity lying almost horizontal on the surface of the leaf; mature ascocarp black, filiform, extremely slender, straight or slightly flexuous, measuring 1–1.5 mm. in length, composed of an essentially basal ascigerous enlargement and a long hair-like beak; enlargement 100–125 μ in lateral diameter and approximately 225 μ in length, tapering above into the beak; asci clavate on long, slender stalks, apparently 8-spored; ascospores seen only in the very immature condition; paraphyses lacking; spermogonia not observed.

The above diagnosis is based on the writer's own study of a portion of the original collection recently made available to him. As broken ascocarps spoiled the specimen for photography, no illustrations of the species are provided here. The drawings of

FIGS. 33–35. *Caliciopsis Symploci.* 33, ascocarps radiating from stromata on twigs and leaves of *Symplocos obtusa,* × 2. 34, single group of ascocarps on enlarged portion of petiole, × 11. 35, asci and mature ascospores, × 730.

Arnaud picture the various structures correctly and adequately. Though the form of the ascocarp and the appearance of the ascospore-initials indicate that the species belongs in or near *Caliciopsis*, its inclusion is only tentative.

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CONTRIBUTIONS TO THE MYCOFLORA OF BERMUDA—III

F. J. Seaver and J. M. Waterston

(with 3 figures)

Our fourth visit to Bermuda covered almost exactly the same period as the previous one (Nov. 24–Dec. 12), and while many of the same forms were re-collected, there were a number of marked differences. In 1938 *Clavaria vermiculata* Mich. was found to be quite common and widely distributed in the Islands. It was especially interesting because it was the first *Clavaria* to have been reported from Bermuda. The senior writer remarked at the time that he was certain this fungus had not occurred there during his previous visits, although these were made at about the same season of the year. Notwithstanding the fact that it was found to be rather common in 1938, not a single specimen was observed in 1940, although the same ground was covered. This illustrates again the sporadic habits of many of the fungi, and emphasizes the necessity of revisiting a region if one is to get a thorough knowledge of its fungous flora.

In contrast with the above, we should mention the rare puffball *Lycogalopsis Solmsii* E. Fischer. Two or three specimens of this were collected in 1938, in one of the sinks in the Walsingham region, and because of its unusual occurrence in the western hemisphere it attracted special attention. In 1940 the same sink was thoroughly searched and the fungus found to be well established, and a goodly amount of material obtained.

This would indicate that some fungi are rather constant in their occurrence from year to year, while others apparently occur spasmodically. While the nature of the substratum has much to do in determining the distribution of the fungi, other factors must enter into the problem, for in no other way can we account for the fact that certain forms occurring on humus may be found year after year in the same locality, while others like the *Clavaria* will be

found only once in several years. Of course, those species which occur on decaying plant materials are likely to be constant in their appearance, such as *Pithya Cupressi* and *Pseudopithyella minuscula* on *Juniperus; Nectria Lantanae* on *Lantana; Calonectria Umbelliferarum* on *Foeniculum;* and *Ophionectria cylindrothecia* on the native palm *Sabal bermudana.* The strictly parasitic species are also likely to be constant.

During our 1940 visit a number of interesting observations were made on species previously reported, while a goodly number of additions were obtained. Also, a few are here recorded as new to science. The new records for the Islands are indicated with an asterisk. Where not otherwise indicated, collection numbers in italics are our own.

DISCOMYCETES

ASCOPHANUS BERMUDENSIS Seaver.

This species has recently been reported from Florida by Erdman West (Mycologia **33**: 38. 1941).

PSEUDOPITHYELLA MINUSCULA (Boud. & Torrend) Seaver.

This species, formerly known only from Portugal and Bermuda, has recently been reported from the Yosemite Valley, California, on incense cedar (*Libocedrus decurrens* Torr.). The senior writer has had the privilege of examining Californian material and finds it identical with the Bermuda collections.

*CENANGELLA DEFORMATA Peck (FIG. 2).

Two collections of this species were made on the bark of cedar, *Juniperus bermudiana.* It was previously known only from New York, Montana and Wyoming. Bermuda material, *337,* agrees very well with other material examined.

HELOTIUM ATROSUBICULATUM Seaver & Waterston (FIG. 1, lower).

This fungus was re-collected in 1940 on dead leaves of *Archontophoenix* in the same general region as in 1938. Dr. Lawrence White reports that this species was twice collected by Dr. David Linder in British Guiana and Trinidad in 1923 on the same host.

Helotium Conocarpi sp. nov. (FIG. 1, upper).

Apothecia gregarious at first subglobose and subsessile, becoming expanded and short stipitate, reaching an extreme diameter of 3 mm., the hymenium usually remaining concave, the margin even or nearly so; hymenium with a delicate lilac tint, externally nearly the same above, darker toward the base; stem scarcely exceeding 1 mm. in length; asci clavate, reaching a length of 50–60 μ and a diameter of 6 μ, 8-spored; spores ellipsoid, hyaline $4 \times 10\ \mu$; paraphyses filiform, scarcely enlarged above, about 2 μ in diameter.

Apotheciis gregariis primo subglobosis, subsessilis, dein expansis, brevi stipitatis, 3 mm. diam.; hymenio concavo, lilacino; stipitibus 1 mm. altis; ascis clavatis 6×50–$60\ \mu$, 8-sporis; sporis, ellipsoideis, hyalinis $4 \times 10\ \mu$; paraphysibus, filiformibus, 2 μ diam.

On dead leaves of *Conocarpus erectus* L., *375, 425.*

This fungus was found to be rather abundant on the fallen leaves of its host. However, the cups are often so small, and even when expanded so nearly like the substratum in color, that very close search is necessary to find them.

SCLEROTINIA SCLEROTIORUM (Lib.) de Bary.

This species attacks over forty different hosts in Bermuda. It was found locally for the first time on a monocotyledenous host, the Dwarf Cavendish banana, *Musa Cavendishii* Lamb., by T. A. Russell, causing a rot of the fruit and sterile flowers. This host record has only previously been recorded by I. Reichert and E. Hellinger from Palestine.

*RUTSTROEMIA NERII Whetzel & White, Lloydia **4**: 226. 1941.

This species reported on fallen, decaying leaves of *Nerium Oleander* L. was based on material collected by the senior writer and H. H. Whetzel on a joint exploring expedition to the islands during the winter of 1926.

STICTIS COCCOLOBII Seaver & Waterston.

This species was described in 1940 from material collected in 1938. During a visit to Florida the last week in February, 1942, a second collection was made on *Coccolobis* leaves in Bay Front Park, Miami, it will probably be found to be widely distributed.

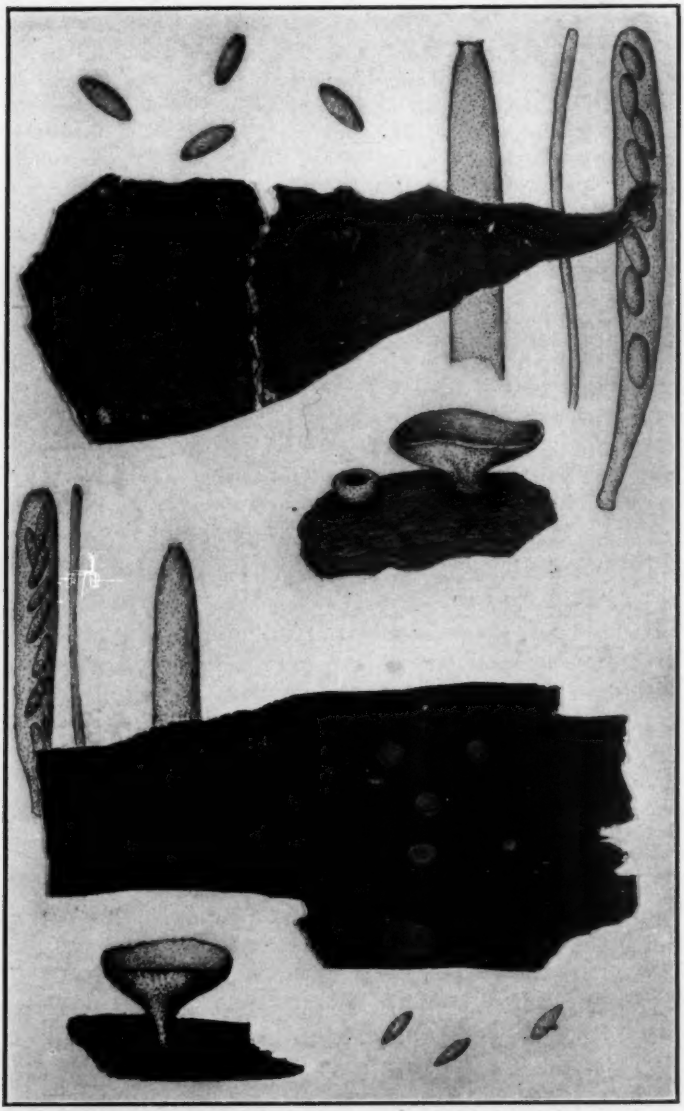

FIG. 1. Upper, *Helotium Conocarpi;* lower, *Helotium atrosubiculatum.*

STICTIS CONOCARPI Seaver & Waterston.

This species, previously known only from a scant collection made in 1926, was re-collected by the junior author in Devonshire, March 25, 1942. Several fine specimens were obtained.

PYRENOMYCETES

Amphisphaeria fusispora sp. nov. (FIG. 3, lower).

Perithecia widely scattered, appearing flattened with their bases nestling in the substratum, rounded or slightly compressed, black, 200–250 μ in diameter, the ostiole indistinct; asci clavate, reaching a length of 125–150 μ and a diameter of 20–30 μ, 8-spored; spores irregularly 2-seriate, fusiform 1-septate, slightly constricted in the middle, 12 $\times$ 60–70 μ, at first hyaline becoming rather dark brown, containing several large oil drops.

Peritheciis sparsis, magnis, depressis, atris 200–250 μ diam.; ascis clavatis, 20–30 $\times$ 125–150 μ; 8-sporis; sporis distichis, fusiformibus, hyalinis dein fuscis, 1-septatis, medio leniter constrictis 12 $\times$ 60–70 μ.

On bark of cedar, *Juniperus bermudiana 370.*

The species is distinguished by its unusually large fusiform spores.

*ANTHOSTOMELLA NIGROANNULATA (Berk. & Curt.) Sacc.

This species was described from material collected in Cuba and is probably co-extensive with its host, *Yucca aloifolia* L. Excellent material from Bermuda is a noteworthy extension of range, *364.*

*BOTRYOSPHAERIA RIBIS (Tode ex Fries) Grossenbacher & Duggar.

This species was found on dead aerial portions of cuttings of cassava, *Manihot utilissima* Pohl., which appears to be a new host record. Ascospores measured 12.5–24.0 $\times$ 6.9–10 μ and averaged 18.8 $\times$ 8.4 μ. Single ascospore cultures gave rise to a *Dothiorella* stage which Dr. N. E. Stevens kindly examined and pronounced typical of the species. Inoculation experiments proved the fungus to be only weakly parasitic.

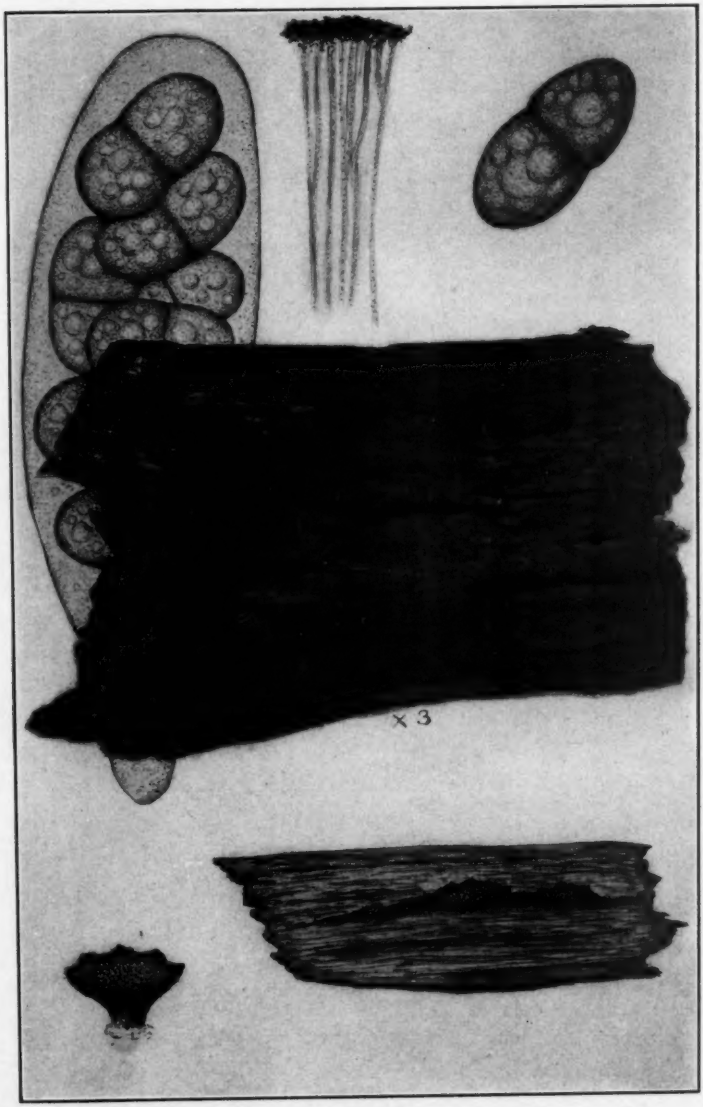

FIG. 2. *Cenangella deformata.*

*DIDYMOSPHAERIA ANDROPOGONIS Ellis & Langlois (FIG. 3, upper).

Material collected in Bermuda on *Andropogon Schoenanthus* L., has been compared with type material and found to agree perfectly. So far as can be learned, this species was previously known only from the type collection obtained in St. Martinsville, Louisiana, and described more than fifty years ago (Proc. Acad. Sci. Phila. **1890**: 235). The spores are delicately striated, a character which was not mentioned in the original description, *315*.

ENDOTHIA COCCOLOBII Viz.

This species was described from material collected in Bermuda by H. H. Whetzel in 1921–22 (Mycologia **15**: 115. 1923). The fungus was originally reported on fallen green fruits of *Coccolobis uvifera* (L.) Jacq. The writers, during our explorations in 1940, noted a bright orange *Endothia*-like growth on the branches and trunks of the above host. Examination of type material has convinced us that this is *Endothia Coccolobii* and that it is probably not restricted to the seeds, as at first thought, *326*.

*NEUROSPORA SITOPHILA (Mont.) Shear & Dodge.

The conidial stage was collected on old paper, *314*. The material was identified by Dr. B. O. Dodge and the perfect stage produced by him in culture.

PENZIGIA BERMUDENSIS J. H. Miller.

The species first collected in 1938 was re-collected in 1940 and found to be very abundant on dead twigs of fiddlewood, *Citharexylum spinosum* L., on which it was originally collected, although this was not identified when the description was published, *371*.

BASIDIOMYCETES

AGARICUS CAMPESTRIS L.

Artificial culture of a white strain of this species imported from the United States of America was attempted on an amateur scale at the Agricultural Station on a compost composed of horse manure

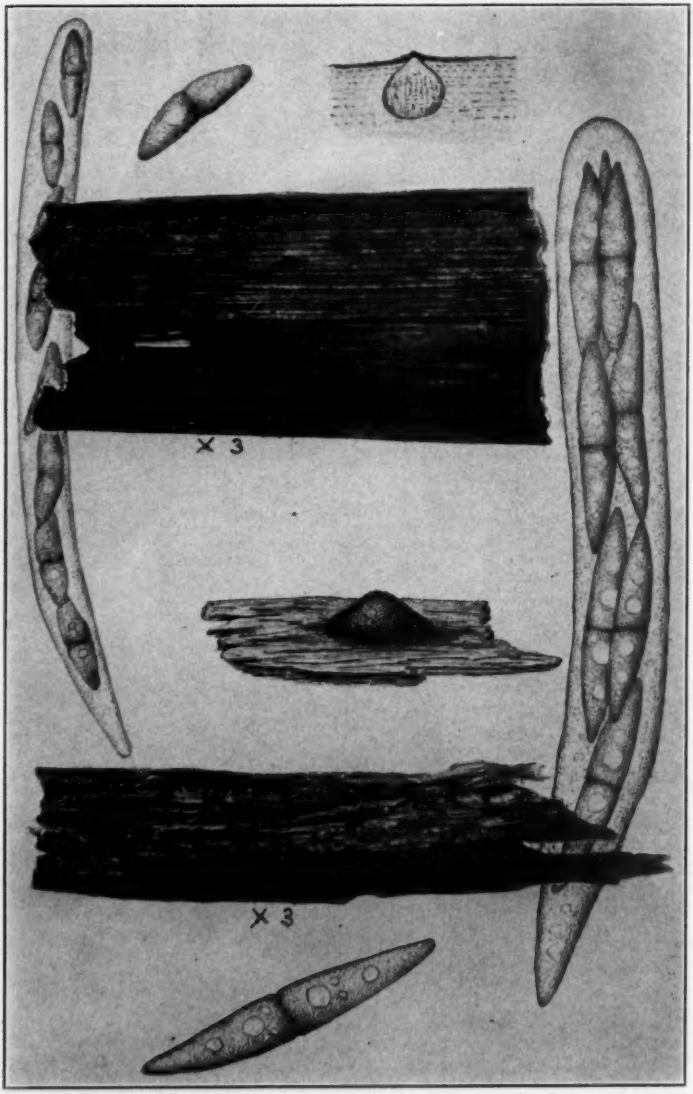

FIG. 3. Upper, *Didymosphaeria Andropogonis;* lower, *Amphisphaeria fusispora.*

from grain-fed animals and "Pond Shags," *Typha angustifolia* L., which is locally used as a substitute for straw bedding. A yield of nearly one pound per square foot was obtained during the winter months.

POLYPORUS GRAMINICOLA Murrill.

This interesting species was found for the first time in the absence of a monocotyledonous host, underneath a hedge of *Acalypha Wilkesiana* Muell. Arg. at the Agricultural Station. The sporophore measuring 8 × 5½ inches was attached to a rotten stump.

*UROMYCES BERMUDIANUS Cummins.

This species was recently described from material collected on *Cyperus paniculatus* Rottb. by the writers on November 28, 1940, *351*. (See Bull. Torrey Club **68**: 470. *f. 1.* for detailed discussion and illustrations.)

The following basidiomycetes have been identified by Miss E. M. Wakefield: **Auricularia polytricha* (Mont.) Sacc. on an old stump of fiddlewood, *Citharexylum spinosum* L.; **Daedalea Berkeleyi* Sacc., causing extensive rotting to an old fence rail; **Odontia arguta* (Fr.) Quél., on fallen logs of *Casuarina equisetifolia* L.; **Peniophora cinerea* (Pers.) Cooke on *Acalypha Wilkesiana* Muell. Arg.; and **Polyporus gilvus* (Schw.) Fries on fallen logs of *Casuarina equisetifolia* L., and *Juniperus bermudiana* L.

FUNGI IMPERFECTI

*CERCOSPORA GUANICENSIS Young.

This species, originally described from material collected in Porto Rico on *Guilandina crista* (L.) Small, was found in abundance on the same host in Bermuda, *321*.

*DIPLODIA THEOBROMAE (Pat.) Nowell.

This species was found responsible for considerable wastage to tubers of cassava, *Manihot utilissima* Pohl. following stormy weather. The fungus behaved as a wound parasite, entering

through cracks caused by wind damage. Pycnidia were found on dead aerial portions of the stems associated with perithecia of *Botryosphaeria Ribis*. Cultural studies, however, revealed no connection between these two fungi.

*OZONIUM AURICOMUM Link.

This sterile mycelium was found on dead stems of *Osmunda cinnamomea* L. It occurs on various substrata in North America and the West Indies, as well as in Europe, *330*.

*PESTALOTIA MICHENERI Guba.

On the inflorescence of *Araucaria excelsa* R. Br. Found abundantly on dead inflorescence of the above host, *320*.

*SEPTORIA ACICOLA Thüm.

On needles of *Pinus palustris* Mill. N. L. Britton in his Flora of Bermuda reports a single tree of this species at Inglewood. This is probably the only tree of the species in the Islands, and the fungus was found on the needles of this tree, *384*.

XENOSPORELLA BERKELEYI (Curtis) Linder.

This species has been determined by Dr. David Linder from material collected on the dead poles of *Agave* associated with *Patellaria atrata, 332b*. The species is closely related to *Helicoma larvale* Morgan, which had been previously reported from Bermuda by us on *Sabal*. It seems likely that all the collections filed under the name of *Helicoma larvale* Morgan are *Xenosporella Berkeleyi*. This should not be confused with *Helicomyces roseus* Link which occurs on the same host Sabal and is always associated with *Ophionectria cylindrothecia* Seaver.

NEW YORK BOTANICAL GARDEN
AND
DEPT. OF AGRICULTURE,
PAGET EAST, BERMUDA.

CILIOSPORA ALBIDA

H. H. WHETZEL

(WITH 1 FIGURE)

On December 2, 1941, leaves of *Prunus serotina* invaded by *Rutstroemia pruni-serotinae* Whet. & White were placed on moist sand in a large moist chamber to observe the development of apothecia. These leaves, which had fallen during the autumn of 1941, showed the net-like black stromata of the *Rutstroemia* already developed. Apothecia began to appear in about two weeks.

On certain of the leaves in one of the moist chambers there were observed at the same time scattered minute white gelatinous masses which aroused my curiosity. A mount of the gelatinous ooze disclosed under the low power of the microscope innumerable large hyaline cylindrical spores with rounded ends, each spore adorned with long, slender, spine-like, hyaline appendages (FIG. 1). The spores are one-celled, and shaped strikingly like long medicine capsules. The mature spores are unusually uniform in size measuring $35 \times 10\,\mu$. The appendages are borne typically in pairs about each end of the spore, usually two pairs at each end, with occasional spores bearing an extra pair or two along the side. In the typically 8-appendaged spores, one pair, at what appears to be the tip end of the spore is longer and larger than the other pairs. The appendages of the longer pair are approximately the length of the spore, those of the other pairs being somewhat shorter and more slender at the base. Some mature spores have fewer than 8 appendages, some probably broken off, but rarely more than 8. In many cases a bead-like drop of a hyaline gelatinous material is to be observed surrounding each appendage at or toward its base (FIG. 1). The walls of the spore are thin, the contents very granular.

Crushed mounts of the fruit bodies disclose that the spores are produced singly on the ends of very slender long hyaline conidio-

phores, which arise from the circular embedded base of the fruit body. The young spores are at first without appendages.

The fruit body about 1 mm. in diameter arises within the leaf tissues and breaking through the epidermis, forms a short columnar mass not more than 2 mm. tall. It appears to consist of a rather thick walled cylinder, the wall composed of interwoven very slender

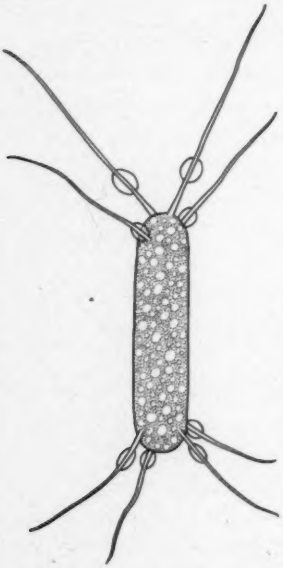

FIG. 1. A typical spore of *Ciliospora albida*. Drawn from mature living spore. The oval bodies on the appendages are drops of mucilaginous material. Approximately × 1000. Drawing by Regina S. Brinkerhoff.

hyphae held together by a gelatinous matrix. The spores which are produced in immense numbers are likewise embedded in a mucilaginous material, which causes them to ooze slowly from the ruptured apex of the fruit body. They soon separate and diffuse rapidly into the surrounding water, occasionally darting forth as if propelled with some force. This pearly white mass of spores gives the dominant white color to the freshly sporulating fruit body. The low wall of the fruit body is, however, of a reddish

brown color. On drying the gelatinous fruit body appears as a minute dried drop of glue of a translucent amber color.

Repeated attempts to germinate the spores in dilution plates of acidified potato dextrose agar failed, so that it has not been obtained in pure culture. In hanging drops of water in which bits of cherry leaf were placed along with the conidia, germination of many spores was observed. The germ tubes appear to develop from the appendages which enlarge slightly and branching form a thallus of very slender spreading hyphae. The young unappendaged spores were also observed to germinate by very slender branching germ tubes.

IDENTITY OF THE FUNGUS

Dr. David H. Linder, to whom fresh specimens were sent, suggested that this fungus appears to be *Dilophospora albida* Mass. & Crossl.

A comparison of the characters of our fungus with the original description of *D. albida* discloses no striking differences. *D. albida* as originally described from dead stems of *Epilobium hirsutum* in England is said to have 3–6 appendages to each spore, the spores 30–40 × 7–8 μ, sometimes slightly curved. The spores of our fungus while corresponding fairly well as to size are rarely curved and when mature bear typically 8 appendages clearly paired.

Grove (**1937**: 117–118) redescribed *D. albida* transferring it to the genus *Ciliospora* of Zimmermann (**1902**: 217). Grove's description appears to be based upon a reëxamination of the Needham collection of August 1890, the dried specimen upon which Massee and Crossland based their original description of the species. This may account for the somewhat smaller spore measurements.

A comparison of our specimen with Grove's revised description leaves little doubt in my mind as to the identity of my fungus with that of Massee and Crossland.[1]

[1] This conclusion is supported by Dr. E. W. Mason of the Imperial Mycological Institute, Kew, England, who has kindly made a critical comparison of a specimen from my collection with the type of *C. albida* (Mass. & Crossl.) Grove. (Letter of May 28, 1942 received after this paper had gone to press.)

The differences appear to be as follows:

Ciliospora albida	Whetzel's specimen
1. Spores oblong fusoid.	1. Spores oblong cylindrical.
2. Meas. 28–40 × 6–8 μ.	2. Meas. 35 × 10 μ.
3. Spores faintly colored.	3. Spores hyaline.
4. Appendages 0–5 per spore.[2]	4. Appendages 8, in pairs, occasionally more or fewer.

Otherwise Grove's revised description tallies well with the characters of the fruit body, etc. of my fungus. The differences pointed out above may not be significant and due to the fact that the original as well as Grove's revised description is based on long dried material while my observations have been made entirely on the fresh growing fungus.

The question as to the genus to which my fungus should be referred is an interesting one. The genus DILOPHOSPORA was established by Desmaziere (**1840**: 6–7) for the pathogenic fungus *D. graminis* Desm. occurring on numerous grasses in Europe and originally described by Fries (**1828**: 91) under the name *Sphaeria Alopecuri*. Later Bessey (**1906**) called attention to the fact that Fries had later transferred the species to Desmaziere's genus under the name *Dilophospora Alopecuri* Fries which name has since been generally accepted for the fungus (Grove **1935**: 449). The most complete and extensive paper on this fungus and its synergistic relationship to *Tylenchus Tritici*, the cause of nematode disease of wheat, rye, etc., is that by Atanasoff (**1925**).

An examination of specimens and descriptions of *D. Alopecuri* in comparison with Grove's (**1935**) description of *Ciliospora albida* should convince any one that the two species are generically quite distinct and unrelated.

Zimmermann (**1902**) established the genus CILIOSPORA for a species of fungus occurring on rotting pods of Cacao in Buitenzorg, Java, to which he gave the name *C. gelatinosa*. It is at once obvious on comparing the description of *C. albida* as detailed by Grove, with that of *C. gelatinosa*, that the two species are cogeneric, but probably distinct. Although Grove makes no comment

[2] According to Groves; Massee and Crossland give the number as 3–6.

on his transfer of *Dilophospora albida* Mass. & Crossl. to Zimmermann's genus *Ciliospora* it is obvious that he recognized the fact that it is not a *Dilophospora* but is clearly co-generic with *Ciliospora*.

As far as I have been able to discover, my collection of *Ciliospora albida* on fallen leaves of *Prunus serotina* is the first record of this species in America and apparently the second known collection in the world. It seems therefore worth recording as a very interesting little fungus. It would be of interest to know what the perfect stage of this conidial form is. Failure to get it in pure culture has been a disappointment but I shall continue to look for the species in the future hoping to find some ascogenous form of which it is most likely the conidial stage.

Whether of any significance, it should be recorded that on leaves in which this imperfect occurred, few or no apothecia of the *Rutstroemia* developed, while from nearby leaves apothecia arose in numbers. That apothecial development may have been inhibited by pathogenic action of the *Ciliospora* is an interesting speculation.

The specimen of *Ciliospora albida* on which this note is based, was developed in a moist chamber in the laboratories of the Department of Plant Pathology at Cornell University on leaves of *Prunus serotina* collected December 2, 1941, by H. H. Whetzel and John Niederhauser in the Lloyd Preserve at McLean near Ithaca, New York. The specimen is deposited in the herbarium, Dept. Plant Path., Cornell Univ. under the number *29792*. Duplicate material is deposited in the Farlow Herbarium, Harvard University.

During February 1940, there appeared on dead petioles of a palm, *Achrontophoenix Alexandrae*,[3] in a moist chamber in my laboratory the fruit bodies of a conidial form bearing long appendaged spores, associated with the stromata of *Helotium atrosubiculatum* Seaver & Waterston (**1940**). The fruit bodies were minute gelatinous cushions essentially like those of *C. albida*. Thinking this conidial form might be a stage in the life history of *H. atrosubiculatum*, dilution plates of the conidia were made and the

[3] The material had been sent me by J. M. Waterston of the Bermuda Experiment Station.

fungus obtained in pure culture. Some preliminary sketches and spore measurements were made by Dr. W. L. White. Comparison of the conidial cultures with those of ascospore isolates of *H. atrosubiculatum* soon satisfied me that the two fungi were not genetically connected.

The appendaged conidia grew readily in non-acid potato dextrose agar but refused to grow on acidified agar. The culture formed a limited white mycelial mat with masses of naked sporodochia of a pale pinkish yellow color. Typical appendaged conidia were produced in great abundance. No attempt was made at the time to identify the interesting little imperfect. Since it was clearly not the conidial stage of *H. atrosubiculatum* nothing further was done with it.

When *C. albida* turned up last December, Dr. White reminded me of the appendaged spore form we had previously found on the palm leaves from Bermuda. Unfortunately the cultures of that fungus are now dead. Attempts by both myself and Dr. White to locate fruit bodies on the dried specimens of the palm petioles which had been preserved have proven fruitless. White's sketches and spore measurements, however, correspond more closely with those of *C. gelatinosa* as given by Zimmermann (**1902**); White's measurements are 26–33 × 5.6–8 μ, Zimmermann's 15–30 × 5–6 μ. Since the Bermuda fungus comes from a tropical habitat the limited data now available would seem to suggest its identity with *C. gelatinosa* from Java rather than with *C. albida*. Further collections and studies may even prove these two species to be one and the same.

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STUDIES IN THE GASTEROMYCETES VI

W. H. Long

Through the kindness of Mr. John A. Stevenson, I have been able to examine the types of *Bovistoides simplex*, *Bovistoides Torrendii* and *Phellorina macrospora*. The following data give the results of my studies of these three *Gasteromycetes*.

THE GENUS BOVISTOIDES

Bovistoides simplex Lloyd. This species was based on a single plant collected in the Transvaal, South Africa, by Miss A. V. Duthie. A description of the genus and species is given by Lloyd in his Mycological Writings **6**: 883 with figures 1517 and 1518. Figure 1517 shows the plant natural size, while figure 1518 is a photomicrograph of the spores and capillitium, magnification not stated but probably about 100 diameters.

The genus *Bovistoides* is based entirely on the character of the capillitium, which is described as having "short, simple (rarely branched) threads running into points." The type of the genus is *Bovistoides simplex*. The type specimen (Lloyd's Cat. No. *32447*) is old, weathered, torn and wrinkled on top. About ¼ of the plant has been cut away exposing to view the glebal cavity.

My examination showed the following: the surface is silvery brown and rough; the base of the specimen plainly shows **7** little finger-like stubs typical of the external columellae of *Myriostoma*, while in the glebal cavity **7** columellae are also visible. The color, columellae, spores and capillitium are identical to those of *Myriostoma coliforme* Corda. This type specimen is evidently an old spore sac of a much weathered and depauperate plant of *M. coliforme* which became *detached* from the outer star-shaped exoperidium. This is clearly shown by the external stubs of the columellae on the base of the specimen, the typical columellae in the glebal cavity, the silvery brown, rough surface and especially by the spores and capillitium typical of a *Myriostoma*. I have

numerous specimens of *Myriostoma* which have the spore sac torn from the exoperidium, as in Lloyd's plant. In view of the above data *Bovistoides simplex* becomes a synonym of *Myriostoma coliforme*.

Bovistoides Torrendii Lloyd. This species was based on a single specimen collected in Brazil, South America, by the Rev. C. Torrend. A description of this plant is given by Lloyd in his Mycological Writings **7**: 1116 and is illustrated by figure 2108 showing the specimen natural size while figure 2109 is a line drawing of the capillitium and spores.

The type specimen (Lloyd's no. *32448*) is well preserved and is a globose plant about 5 cm. in diameter with a 2-layered peridium having a round central opening in the top, and a short radicating base where it was attached to the substratum (wood); *exoperidium* wrinkled, tough, glabrous, 1–2 mm. thick, dull brown, not deciduous except a small portion around the apical opening. This apical opening does not seem normal but appears as if made by some outside agency, possibly when the plant was collected; *endoperidium* hard, rigid, about 1 mm. thick at stoma, exterior surface brown where exposed, edges cupped into the gleba as if pushed inward by some foreign agency. Sterile base none. *Gleba* in mass dark brown to sooty black consisting of spores, capillitial threads and a hyaline tissue in which the spores and capillitium are embedded. Definite strings of this glebal tissue protrude into the glebal cavity from the walls of the endoperidium. These protruding strings are 3–5 mm. long, and consist of spores and bundles of the capillitial threads. The gleba becomes very powdery and dirty with age. The *capillitial threads* are short, thick with pointed ends, unbranched, brown, solid, walls smooth, 12–16 microns thick in center, 250–600 microns long (see Lloyd's figure 2109). *Spores* globose, fuligenous, 1-guttulate in water mountant, 4–5 microns in diameter; *epispore* black, appearing rough.

The general aspect of this specimen suggests that it was immature when collected and that its true manner of dehiscence is not shown. The plant resembles an unopened *Myriostoma coliforme* but the glebal characters exclude it from this species.

Since the type of *Bovistoides simplex* has been shown to be a synonym of *Myriostoma coliforme*, the question arises as to the

validity of the genus *Bovistoides* and the correct name for *Bovistoides Torrendii*. I am leaving this name unchanged although the plant on which the genus was established is entirely different from *B. Torrendii*. If the genus *Bovistoides* is maintained it will have to be based on the Brazilian plant *B. Torrendii* and the generic description emended.

PHELLORINA MACROSPORA Lloyd

This species was described from a single plant found in California by S. B. Parish. The type collection (Lloyd's No. *25529*) has two labels with it; one on the top of the container reads as follows: "*Phellorina macrospora*, San Bernadino, California, S. B. Parish, Oct. 22, 1912—Type." Inside the box is a label reading "Plants of Southern California No. 8212, Coll. S. B. Parish, Oct. 1912, Mecca, Colorado Desert." Also in the box is a typed manuscript which was published by Lloyd in Vol. VI, Letter 44, note 50 as his original description of this species.

The type specimen consists of one plant having a stipe and a flattened pileus with one side broken off but still in the box. The *pileus* or *sporocarp* is 2 cm. across, apparently sub-globose when fresh, exterior dirty white, more or less scaly and breaking loose around the stipe. *Stipe* 28 mm. tall by 6 mm. thick, yellowish brown, smooth, equal, with a small ball of dirt 7 mm. thick at base; the stipe is percurrent through the pileus forming a *columella* 8 mm. long by 3 mm. thick and apparently attached at its apex to the endoperidium. *Gleba* yellowish brown, rather firm and caked; *capillitium* scant, hyaline, threads flattish to terete; *spores* with a 2-layered wall, subglobose, short elliptical to obovate, truncate, germ pore at apex, very variable in size, 9–11 by 12–16 microns; *epispore* smooth, hyaline, subhyaline to yellowish brown, about 4 microns thick.

This plant is undoubtedly a *Podaxon*—a small, depauperate, immature specimen of *Podaxon pistillaris*. It has the typical sporophore and spores of a *Podaxon* and not those of a *Phellorina*.

Lloyd did not adequately describe this so-called new species of *Phellorina* as the following quotation from his original description shows. "From S. B. Parish, Southern California, I previously

had the opinion that *Phellorina* was probably a monotypic genus as the various named species seem to me very much the same, and all have the same spores, globose, 5–6 microns in diameter. This plant has very large spores 16–18 microns. Mr. Parish found one (immature and not well developed) plant at Mecca, Colorado Desert. In addition to the large spores of this plant, it is of much interest as the genus is of greatest rarity in the United States." No description of the plant is given other than the size of the spores (16–18 microns), not even the shape, color or markings of the spores are noted. I therefore consider the name—*Phellorina macrospora*—as *nomen nudum* in addition to being a synonym of *Podaxon pistillaris*.

ALBUQUERQUE, NEW MEXICO.

NOTES ON ARAIOSPORA STREPTANDRA[1]

LELAND SHANOR AND LINDSAY S. OLIVE

(WITH 11 FIGURES)

The genus *Araiospora* Thaxter of the Leptomitaceae is unique among aquatic Phycomycetes in that the oöspores borne singly in the oögonia are surrounded by a cellular envelope which is derived from the periplasm. In North America the species which have been reported have all been collected in New England or New York (**1**). No reports have hitherto been published of species having been collected south of New York and Rhode Island. Of the four known species, three seem to prefer colder climates while only one has been found in tropical countries (**4**). On the basis of published data, the two species that are known from the United States are rare and appear to be confined to rather limited areas. *Araiospora pulchra* Thaxter (**6**), the type species for the genus, has been collected in Maine, Massachusetts, and New York (**6**, **5**, **3**), while the other species, *A. streptandra* Kevorkian (**2**), is known only from collections made around Kingston, Rhode Island and Cambridge, Massachusetts (**2**). The present report of collections of a form of this second species from North Carolina extends considerably its known geographical distribution in the United States.

MATERIAL

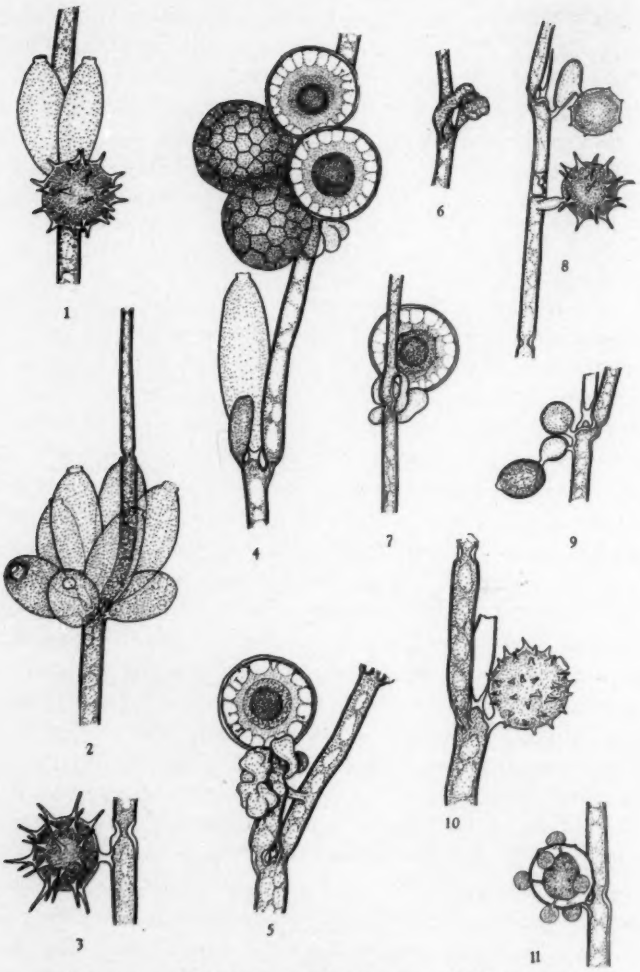
Dead twigs and branches of Cherry Birch (*Betula lenta* L.) obtained from Harbison Lake, Highlands, North Carolina, by the junior author during August, 1939, were carefully examined by us for the presence of aquatic fungi which might be growing on them when brought into the laboratory. Small tufts of a white mycelium appeared rather abundantly on several of these twigs, and an examination of them revealed that they belonged to an *Araio-*

[1] Contribution from the Highlands Biological Laboratory, Highlands, North Carolina.

spora. Although the spinose sporangia of these plants differed rather strikingly in several respects from those of *A. streptandra* as described by Kevorkian (**2**), these differences seemed to us to be within the limits of the possible variation of this species so, largely on the basis of the characteristics of the organs of sexual reproduction, we identified our collection as belonging to Kevorkian's species. No attempt was made to keep the fungus in culture.

OBSERVATIONS

THE THALLUS—Plants consist of a large basal cell on whose sub-conical apex a number of branches arise and from whose base numerous rhizoids develop. The older branches are found in the center near the tip of the cell while the younger ones grow out more toward the base of the conical portion. The branches are constricted at regular intervals with the posterior segments being shorter and of a larger diameter than those immediately above them. At the point of constriction the hyphal walls are considerably thickened and in many instances the wall deposit at these points completely obstructs the opening between segments. From our observations on these collections it appears that whether or not the opening becomes completely obstructed determines to a large extent whether a segment will develop branches. Branches most frequently occur on the sides of the anterior end of segments and in the majority of the cases we have observed, they developed only when terminal growth became obstructed. This obstruction might be either the formation of a terminal zoösporangium (FIGS. 2, 4) or the complete closing of the opening allowing for protoplasmic communication between segments (FIGS. 8, 9, 10). The walls of segments also appear to be weak where a segment has been cut off completely from the one below and numerous cases have been seen where a branch had become completely severed from the parent plant by a breaking of the wall above an obstructed constriction (FIGS. 8, 9, 10). In older plants the first branches which developed near the tip of the sub-conical base are usually missing with only their stubs remaining on the uppermost part of the basal cell. The fate of these branches has not been determined but the possibility that this fragmentation of a plant might serve as a method of



FIGS. 1–11. *Araiospora streptandra* var. *echinulosphaera*.

vegetative multiplication is suspected, provided the portion that becomes free should settle on a suitable substratum.

THE ZOÖSPORANGIA—Zoösporangia of this plant develop at the tip of segments and grow out laterally from the distal end of them. They are of two kinds as is characteristic for the genus.

The thin walled smooth sporangia occur either singly or in clusters of 2–10, vary considerably in size, and are normally clavate or sub-cylindrical in shape (FIGS. 1, 2, 4). The largest clavate or sub-cylindrical sporangia are up to 117.5 μ in length by 41 μ in diameter at their widest point and develop from the larger segments while the mature smaller ones of this shape are no larger than 32 μ long by 26 μ in diameter and are most frequently found on tip segments of the hyphae.

All of the thicker walled echinulate sporangia which were observed in our collections were spherical in shape and were more or less covered with numerous rather evenly spaced conical spines which varied considerably in length (FIGS. 1, 3, 8, 10). The diameter of these sporangia measured between 29.8–48.7 μ while the spines on them are from 3.1–20.4 μ in length and often are slightly curved at their tips. Sporangia of this type usually have between 30 to 50 spines but the largest most echinulate ones may possess as many as nearly a hundred of them. Some of the young spinose sporangia were found to be parasitized by a species of *Rhizophidium* (FIG. 11). Quite a number of cases have been observed where sporangia became arrested in their development for some unknown reason and when development was resumed, tubes were formed which produced at their ends normal functional zoösporangia. The sporangia thus formed may be either the smooth walled or the spinose type (FIGS. 8, 9).

ORGANS OF SEXUAL REPRODUCTION—The sexual organs of the plants in our collections correspond rather closely with those described by Kevorkian (2) for plants observed from New England. Oögonia normally develop either singly or in clusters of 2–6 on branches from the distal end of segments (FIGS. 4–7) and the antheridial branches arise on the same segment (FIG. 6) or the one just above it (FIG. 5, 7). Antheridia of our plant are large, decidedly lobed and toruloid in shape, and become appressed to the base of oögonia after twining around its stalk. Stages in fertilization of the egg have not been followed but we can confirm the observations of Thaxter (6) and Kevorkian (2) that the fertilization tube from the antheridium penetrates the oögonial wall and extends into the oögonium to the region of the oöplasm. Mature

oögonia are spherical, usually measure between 55.2–65 μ in diameter, and each contains a single oöspore. Mature oöspores are between 37.3–42.5 μ in diameter and are surrounded by a layer of cell-like structures derived from the periplasm. These peripheral cells are somewhat hexagonal—appearing in a surface view of oögonia and measure 9–15.7 μ across $\times$ 6.2–9.4 μ deep.

DISCUSSION

The principal characteristics on which species within the genus *Araiospora* are separated are (1) position and relationship of the sexual organs, (2) echinulation of the spinose sporangia, and (3) size of the various reproductive structures. The North Carolina plant on the basis of the first and third of these diagnostic criteria would fit Kevorkian's description of *A. streptandra* rather well but it differs strikingly in the characteristics of the spinose sporangia. The shape of the sporangia in Kevorkian's collections was oval to pyriform while the same type of sporangia in our collections is either spherical or nearly so. The echinulate sporangia of our plant are also much more spinose with the spines sometimes somewhat curved at the tips in contrast to the condition of the spiny sporangia as described and figured by Kevorkian. In the text of his paper Kevorkian says that this type of sporangia of his plant possess from 10–15 spines whereas those of ours rarely have less than 30 and usually have more. As many as nearly a hundred have been observed on the largest, most spinose ones. In addition to the characteristics of spinose sporangia, the antheridia of our plant are larger and more toruloid than those described and figured by Kevorkian. It seems evident, therefore, that the plant which we are here reporting is a distinct variety of *A. streptandra* and we propose the following name suggested by the characteristics of the spinose zoösporangia.

Araiospora streptandra var. **echinulosphaera** var. nov.

Echinula-sporangia sphaerica, 29.8–48.7 μ diam.; spinis numerosis, plerumque 30–50, 3.1–20.4 μ longitudine.

SUMMARY

1. A new variety of *Araiospora streptandra* Kevorkian is described as var. *echinulosphaera* collected on Cherry Birch twigs that had fallen into Harbison Lake, Highlands, North Carolina. This is the first report of any species of this rare genus occurring south of New England and New York on the North American continent.

2. The outstanding characteristics of this species are described and its relationship to *Araiospora streptandra* Kevorkian is discussed. Also an unidentified species of *Rhizophidium* is reported to parasitize the immature spinose zoösporangia.

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EXPLANATION OF FIGURES

All figures drawn with the aid of a Spencer camera lucida. Figs. 2, 3, 6–10, × 250; figs. 1, 4, 5, 11, × 245. Fig. 1. Portion of a hypha bearing two empty smooth zoösporangia and a single spiny one which is still full of protoplasm. Fig. 2. Cluster of smooth zoösporangia at the distal end of a segment. Fig. 3. A spinose zoösporangium. Fig. 4. Portion of a hypha with a terminal empty smooth zoösporangium, a young smooth zoösporangium, and a branch arising at the distal end of a segment. A cluster of sexual organs are borne on the branch. Two of the oögonia are shown in

surface view. Fig. 5. Portion of a hypha with an oögonial branch on which there are two oögonia, one mature and one very immature. The antheridial branch in this case arises from the segment immediately above the one from which the oögonial branch developed. Fig. 6. Young sexual branches arising from the distal end of the same segment. Fig. 7. Portion of hypha with reproductive organs. The stalk of the oögonium is completely hidden by the twining antheridial branch which is wrapped around it. Fig. 8. Portion of a hypha bearing two spinose zoösporangia. The upper immature zoösporangium is formed at the end of a tube from a smooth walled one. The branch developed in this case after the segment above became cut off by wall deposit at the constriction. Fig. 9. Portion of a hypha with two small smooth-walled zoösporangia formed at the tip of one segment. One of these zoösporangia has proliferated to form a second smooth-walled zoösporangium. Fig. 10. Portion of a hypha bearing an empty echinulate thick-walled zoösporangium with short spines. Fig. 11. Portion of a hypha bearing an immature echinulate zoösporangium which is parasitized by a species of *Rhizophidium*.

TWO NEW CHYTRID GENERA [1]

ALMA J. WHIFFEN

(WITH 52 FIGURES)

Two new chytrids, one an epibiotic parasite of *Pythium* and the other an epibiotic parasite of *Rhizophidium*, were obtained by baiting soil collections with boiled grass leaves. Both of these chytrids are new genera of the Rhizidiaceae.

THE PARASITE OF PYTHIUM

The chytrid parasite of *Pythium* is characterized by its mode of parasitism and manner of spore discharge. The *Pythium* host is parasitized by the tips of the chytrid rhizoids which fasten themselves to the host hyphae but do not penetrate the hyphal wall. Spore discharge is accomplished by the dissolution of the sporangial wall, thus liberating the spores, which swim away shortly after the disappearance of the wall. *Solutoparies* is given as the generic name to indicate the peculiar method of spore discharge. The type species is named *S. Pythii.*

Solutoparies gen. nov.

Thallus entirely extramatrical, monocentric. Sporangia developing by enlargement of zoöspore; rhizoidal system much-branched. Spore discharge by dissolution of sporangial wall, liberating the zoöspores which swim away singly. Zoöspore uniguttulate, posteriorly uniciliate. Resting spores unknown.

Solutoparies Pythii sp. nov.

Thallus parasitic. Sporangia ovoid to spherical, 14.3 $\mu \times$ 16.4 μ to 68.4 $\mu \times$ 80.3 μ; wall spiny, spines conical, up to 5 μ in length.

[1] This study has extended over the past two years during the tenure of a research assistantship, supported by grants to Dr. J. N. Couch by the Carnegie Corporation of New York, 1940–41, and by the American Philosophical Society, 1941–42, and during the tenure of a Scholarship at the Highlands Biological Laboratory, Highlands, N. C., summer of 1942.

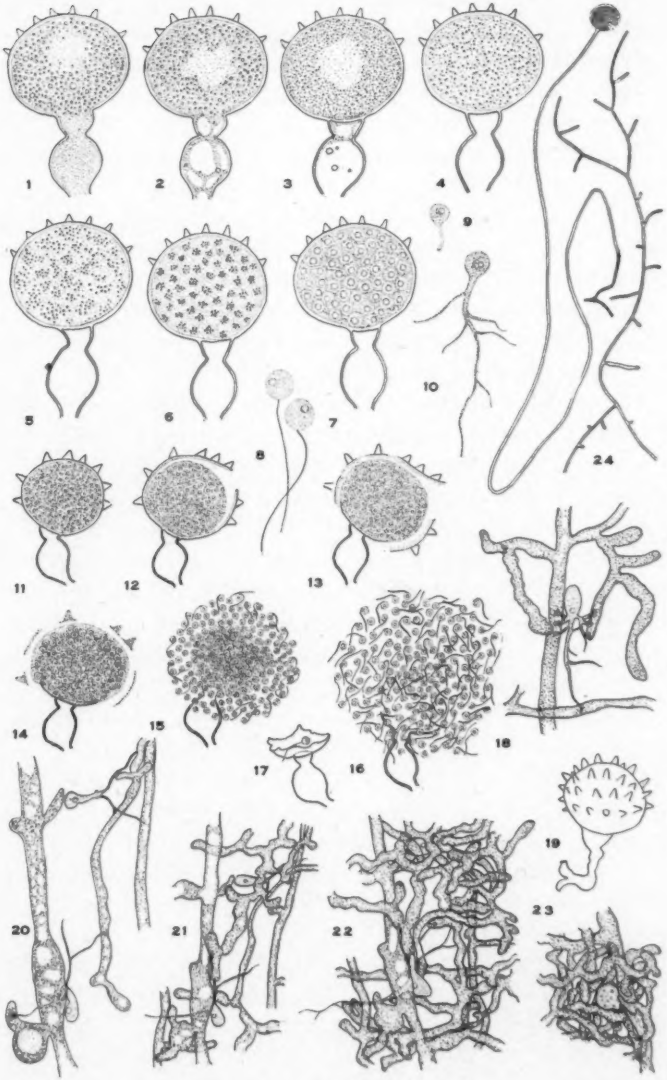
Rhizoidal system cut off by cross wall from mature sporangium, tips of rhizoidal branches adhering to but not penetrating host hyphae. Dissolution of sporangial wall complete except for basal portion, freeing the spore mass, enclosed in a gelatinous matrix; zoöspores separating as surrounding matrix dissolves, swimming away singly. Zoöspores spherical, 4.5 μ to 5.6 μ, hyaline with single colorless oil globule. Resting spores unknown.

Exoparasite of *Pythium* sp. Collected October, 1940, at Chapel Hill, North Carolina.

Solutoparies Pythii was found growing on the grass leaf bait in conjunction with a species of *Pythium*. In an attempt to establish a unifungal culture of the chytrid, mature sporangia were dissected from the leaf and transferred to a piece of boiled grass leaf, immersed in distilled water in a sterile Petri dish. In those culture dishes in which had been placed chytrid sporangia entirely free from *Pythium* hyphae, there appeared no growth of the chytrid. On the leaves, however, which were inoculated with both the chytrid and the *Pythium*, a large number of chytrid sporangia developed among the *Pythium* hyphae. Further study of the cultures revealed that the chytrid was parasitic on the *Pythium*.

Developmental studies of *S. Pythii* were made with chytrid thalli obtained by inoculating the *Pythium* host on hemp seed in water and on agar with spores of the parasite. The agar cultures were used particularly to study the early stages of spore germination and the host parasite relationships.

About one hour after the zoöspore has been placed on agar the germ tube makes its appearance (FIG. 9). Up to a certain stage, the development which follows the germination of the zoöspores is accomplished much more rapidly than that of a comparable degree of development of a typical saprophytic chytrid. In a few hours the rapid elongation and branching of the germ tube results in a germling with a well established rhizoidal system (FIG. 10). Spores on agar plates on which the *Pythium* host is not growing, reach this germling stage but are unable to develop any further. Continued growth of the thallus, therefore, is dependent upon contact being made with the host by one or more of the rhizoidal branches (FIG. 18). Enlargement of the thallus is accompanied by continued branching of the rhizoids, each rhizoidal branch consti-



FIGS. 1–24. *Solutoparies Pythii.*

tuting an additional potential means of absorbing nutriment from the host. As the rhizoidal system increases in extent, there is a corresponding increase in the diameter of the primary rhizoids so that the portion of the rhizoid immediately below the sporangium becomes greatly swollen (FIG. 19).

As the sporangium attains its mature size, blunt pointed spines appear in a cyclic arrangement over the apical half of the sporangium (FIG. 19). Not all sporangia, however, are spiny-walled. Shortly after the formation of the spines the contents of the rhizoids begin to disappear (FIG. 2) and a cross wall develops, cutting off the sporangium from the rhizoidal system (FIG. 3). When the cross wall is complete, the process of the differentiation and cutting out of the spores begins.

The formation of the zoöspores is best followed by observing the changes in the form and arrangement of the oil globules and vacuoles. In the early stages of thallus development the oil globules are large and irregular in size and no well defined vacuoles are visible. As the sporangium ceases to enlarge, a large central vacuole appears within the sporangium (FIG. 1). This central vacuole persists during the stages in which the sporangium is cut off from the rhizoids and the oil globules become smaller and more uniform in size (FIG. 3). The disappearance of the central vacuole is followed by the appearance of numerous small vacuoles scattered throughout the protoplasm (FIG. 4). Then the vacuoles become less evident as the oil globules aggregate in small groups (FIG. 5). The aggregation of the oil globules continues (FIG. 6) until the small globules of each group coalesce into a single large globule (FIG. 7). Around each oil globule a spore is then cut out.

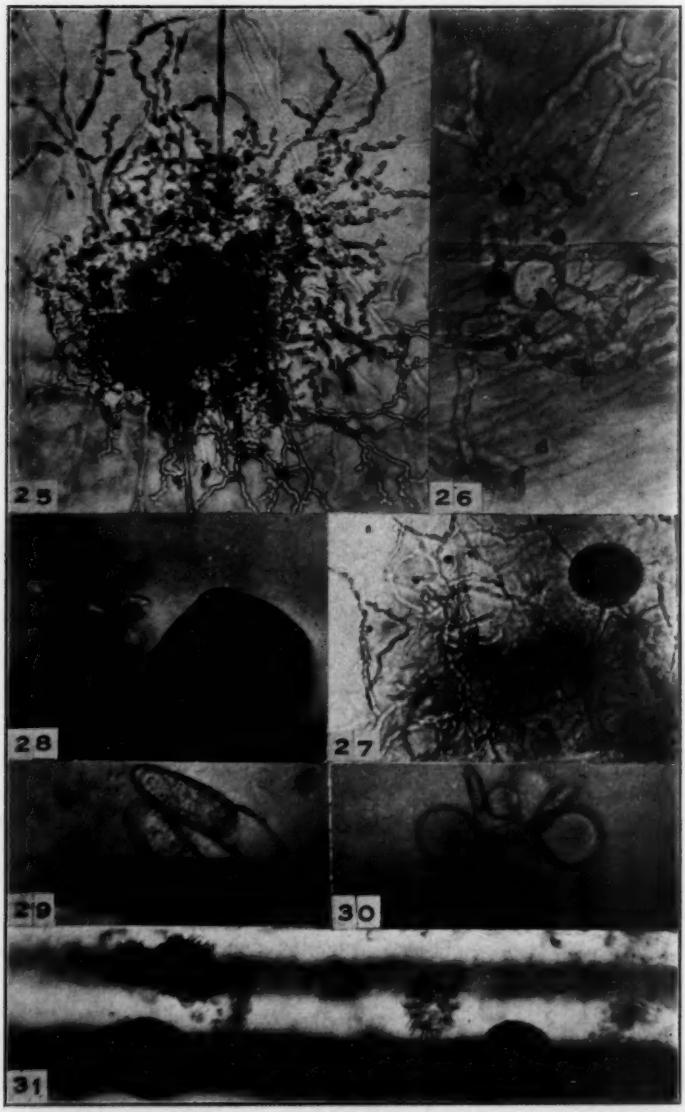
The first indication of spore discharge is the swelling and thickening of the sporangial wall (FIG. 12). Expansion of the wall is accompanied by dissolution of the wall substance (FIGS. 13 and 14), the spines being the last portion to dissolve (FIG. 15). Slowly as the gelatinous matrix enclosing the spores becomes soluble, the zoöspores become active and swim away one by one. All that then remains of the sporangial wall is an irregular collar about the base of the rhizoid (FIG. 17). Each zoöspore is spherical with a long cilium and varies from the typical chytrid spore only in the position

of the single oil globule, which is placed anteriorly and to one side of the center of the spore as it swims (FIG. 8).

It is interesting to observe the effect of the parasite on its host. At a low magnification a young chytrid thallus may be located by the tangled mass of *Pythium* hyphae which surrounds it (FIG. 25). A culture of the host not infected by *S. Pythii* does not produce these knotted masses of hyphae. In agar cultures the progress of the branching of the host about the parasite thallus can be easily followed from the early stages of spore germination of the parasite to its maturity. In figure 20 are shown two germlings of *S. Pythii,* whose rhizoids are attached to three hyphae of the *Pythium* host. Five hours later the abnormal branching of the host has begun (FIG. 21) and after eight more hours the thalli of the parasite are almost obscured by the *Pythium* hyphae (FIG. 22). By the end of the next fifteen hours the chytrid thalli are no longer visible. Branching of the host continues through an increasing area until the parasite has attained its mature size, when disintegration of the parasitized hyphae begins (FIG. 27).

Because of the fineness of the rhizoidal tips of the chytrid, it was difficult to determine the exact relationship of the parasitic rhizoids to the host hyphae. The rhizoids of the parasite do not ramify through nor enter the host but frequently they wrap around the outside of the hyphae. No haustoria of the parasite could be detected within the *Pythium* hypha but where the tip of the rhizoid is attached to the hyphal wall, there is a noticeable aggregation of granules of the host protoplasm just beneath (FIG. 18). The portion of the hypha attacked by the parasite swells but slightly so that hypertrophy of the host is expressed only in increased and abnormal branching of the hyphae. This reaction of the host, of course, is well adapted to the development of the parasite in that the number of hyphal branches in its immediate vicinity from which the chytrid parasite may obtain food is thereby greatly multiplied.

It has not been possible to determine the species of *Pythium* on which *S. Pythii* is parasitic. The *Pythium* was grown on maltose-peptone and corn meal agars as well as on hempseeds and boiled carrot in water cultures but on none of these substrata were



FIGS. 25–31. Photomicrographs of *Solutoparies Pythii* and *Septosperma Rhizophidii*.

oögonia produced. The most striking characteristic of this *Pythium* is its ability to discharge large numbers of zoöspores in water cultures. A period of active spore discharge results in the formation of many large spherical masses of encysted spores. The diameter of the sporangium is equal to or only slightly greater than the diameter of the axial hyphae. In the undifferentiated filamentous character of the zoösporangium, this species of *Pythium* conforms to Schroeter's concept of his genus *Nematosporangium*. In figure 24 are illustrated a typical sporangium in the act of discharging spores and the habit of mycelial branching. A brief description is given below as an aid to the identification of this species of *Pythium* in the future.

PYTHIUM, species undetermined.

Mycelium saprophytic. Axial hyphae, 6.1 μ to 8.2 μ, lateral branches 2.4 μ to 4.1 μ in diameter, coming off mostly at right angles to axial hyphae. Zoösporangium consisting of undifferentiated mycelial elements, rarely branched, 7.2 μ to 8.5 μ in diameter. Zoöspores 6.5 μ to 7.8 μ in diameter when encysted; zoöspore cysts collecting in large, spherical masses. Conidia absent. Oögonia not observed.

One chytrid genus has been described which resembles *Solutoparies Pythii* in its mode of spore discharge. In 1885 A. Borzi (1) described a new genus, *Nowakowskia*, and a new species, *N. Hormothecae*, which is parasitic on the germinating zoöspores of *Hormotheca Sicula*. Though *N. Hormothecae* parasitizes an alga rather than a Phycomycete, in its extramatrical habit it is similar to *S. Pythii*. Borzi, however, states that the rhizoids of his species bore through the cell wall and press into the interior of the algal cell. Several germinating zoöspores may be parasitized thus by a single thallus of *Nowakowskia Hormothecae*. Spore discharge in *Nowakowskia* is accomplished by the dissolution of the sporangial wall just as in *Solutoparies*. The behavior of the zoöspores as described by Borzi is peculiar. After the disappearance of the sporangial wall, the spore mass swims around in the water like a colony of *Volvox*. The spores adhere so closely together that when the swimming spore ball strikes an obstacle, it flattens, elongates on one side, and draws itself around the obstacle,

later resuming its spherical form. Eventually groups of spores detach themselves from the spore mass. Each group assumes a spherical form and begins to rotate in the water. The spore balls continue to break up into smaller and smaller spheres until the spores are completely separated and swim about singly. The sporangium and spores of *N. Hormothecae* are small in size. The diameter of the sporangium varies from 4 to 16 μ and the body of the zoöspore measures only one micron in length. Fischer (**4**) considers *Nowakowskia* as a doubtful genus and suggests that the organism described by Borzi is a Rhizopod. The Volvox-like behavior of the zoöspores of *Nowakowskia* after their discharge is so distinctive that any species placed in this genus should agree with the type species in this respect. Therefore, though *S. Pythii* is similar to *Nowakowskia Hormothecae* in regard to the manner of spore discharge, it is necessary to erect a new genus for our parasite of *Pythium*.

THE PARASITE OF RHIZOPHIDIUM

The correct disposition of the chytrid parasite of *Rhizophidium* is a difficult problem. Because of the lack of a definite, branched rhizoidal system, this chytrid could be considered as a new species of *Phlyctidium* (*Tylochytrium* Karling **7**). The structure of the resting body, however, is distinct from that of all species of *Phlyctidium*, in which the resting body is known, except *P. anomalum* Couch (**3**). The resting body of *P. anomalum* is a cylindrical body, divided by a cross wall into two portions, an apical portion containing several oil globules and an empty basal portion. Such a resting body is possessed by our parasite of *Rhizophidium*. The resting body has been observed in only two other species of *Phlyctidium* in addition to *P. anomalum*.. A spherical resting body has been described by A. Braun (**2**) for *Phlyctidium laterale*. This species was transferred to *Rhizophidium* by Rabenhorst (**6**), and was retained in this genus by Fischer (**4**). Von Minden (**8**) does not recognize the transfer of *P. laterale* to *Rhizophidium*. Karling (**6**), however, has recollected this species and has discovered the presence of delicate rhizoids which necessitates the placing of this species in *Rhizophidium*. Karling also figures a spherical

resting body, containing a single large oil globule. *Phlyctidium anatropum* (Braun) Sparrow has been recently studied by Sparrow (**13**), who transferred this species to *Phlyctidium* from *Rhizophidium* where it had been placed by Fischer. An ovoid resting body was described by Braun for this species but was not observed by Sparrow.

The validity of *Phlyctidium* as a genus has often been questioned. Schroter (**11**) and Fischer (**4**) do not recognize *Phlyctidium* but Serbinow (**12**) and von Minden (**8**) regard it as a valid genus. Scherffel, Sparrow, and Karling all consider *Phlyctidium* as inadequately separated from *Rhizophidium*. Scherffel (**10**) believes that the difference between a branched and an unbranched rhizoid is not so fundamental that it leads to a sharp generic distinction. A similar opinion is expressed by Sparrow (**13**) and Karling (**7**).

The resting body structure of the chytrid may be considered to be distinctive when it differs markedly from the spherical form with a large central oil globule. Furthermore, when the zoösporangial stage of the chytrid lacks distinguishing morphological characters, it may be necessary to resort to the resting body stage for characters of taxonomic value. Since the structure of the resting body of *Phlyctidium anomalum* Couch is different from that of any other previously described chytrid, with one possible exception, the discovery of our chytrid form, which possesses a similar resting body, gives added significance to the peculiar type of resting body found in Couch's species. Scherffel (**10**, Pl. 9, Fig. 16 a, b) figures a stalked resting body which he found on *Gomphonema micropus* and which he considered to be the resting body of *Podochytrium clavatum* Pfitzer, previously unknown. It may or may not be significant that whereas all other species of *Phlyctidium* are parasitic on algae, *P. anomalum* and the chytrid now being discussed are parasites of two chytrid genera, *Phlyctidium* and *Rhizophidium*, respectively. Therefore, it now seems advisable to establish a new genus, in which would be placed *P. anomalum* Couch as the type species and our chytrid parasite of *Rhizophidium*. This genus is characterized by the possession of an elongated resting body, which is divided by a cross wall into an empty basal portion and an apical portion filled with protoplasm and one to many oil globules.

Septosperma gen. nov.

Thallus extramatrical, eucarpic. Zoösporangia, arising by enlargement of zoöspore, spherical, ovoid, or ellipsoid, each sporangium with a single exit pore. Zoöspores uniguttulate and posteriorly uniciliate. Resting bodies elongated, ellipsoid to clavate, divided by cross wall into an empty proximal portion and a distal portion containing protoplasm and one or more oil globules. Zoösporangia and resting bodies attached to host by bulbous, discoid, or slightly branched haustorium.

Septosperma anomala comb. nov.

Phlyctidium anomalum Couch, Jour. Elisha Mitchell Sci. Soc. **47**: 256. *pl. 17. figs. 69–83.* 1932.

The following description is taken from Couch (**3**).

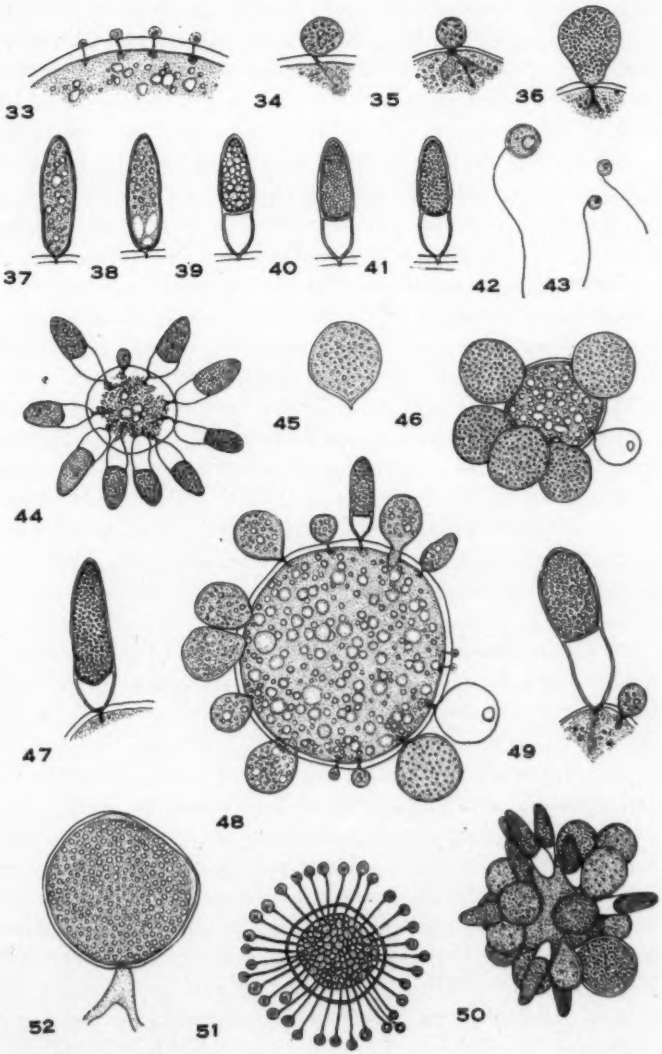
Sporangia sessile, ovoid, or ellipsoid, 4.2–5.5 × 7.3–11.7 μ, anchored to the host by a very small, bulbous, or discoid base. Spore development as in *Rhizophidium globosum*. Spores in sporangium about 1.8 μ thick with a single glistening droplet. Swimming spores not seen. Sporangial discharge through an apical pore. Sporangium collapsing more or less after spore discharge. Resting cells formed from a cell of about the same size and shape as mature sporangium. The protoplasm collects in the distal half of this cell leaving the proximal half empty and around the protoplasm a rather thick wall is formed. Resting cell with 1–3 oil globules. Rarely the mature resting cell may occupy the entire "parent" cell being elliptical in shape. Parasite on *Phlyctidium Bummilleriae* Couch.

Septosperma Rhizophidii sp. nov.

Zoösporangia varying in shape from spherical to pyriform, 8.2 μ to 24.4 μ in diameter, wall smooth with a single inconspicuous exit pore at maturity. Zoöspores spherical, 1.6 μ to 2.0 μ in diameter. Resting sporangia clavate, stalked, 4.1 μ × 16.4 μ to 6.1 μ × 25.1 μ, at maturity stalk empty of protoplasm, apical portion filled with numerous small oil globules. Germination of resting sporangia not observed.

Parasitic on *Rhizophidium macrosporum* at Chapel Hill and Highlands, North Carolina.

Septosperma Rhizophidii has the *Rhizidium* type of development in which enlargement of the spore body gives rise to the mature



FIGS. 33–52. *Septosperma Rhizophidii.*

sporangium or resting body. The wall of the host is penetrated by the germ tube of the germinating zoöspore (FIG. 33). The swelling of the end of the germ tube very soon after its entry into the host protoplasm indicates the formation of a haustorium, which attains its maximal size before the enlargement of the sporangium is completed (FIGS. 34 and 35). The haustorium appears as an aggregation of protoplasm that may be sac-like (FIG. 34) or tenuous and branched (FIG. 35) and is distinguished from the clear host protoplasm only by its greater density.

Usually the mature zoösporangium is spherical except for the conical basal portion, of which the haustorium is a continuation. This basal portion is sometimes expanded so that the sporangium is raised above the surface of the host sporangium.

The actual discharge of the zoöspores was not observed though frequently sporangia were found from which the spores had recently escaped. Discharge of the spores is accomplished through a single circular opening in the sporangial wall. There is no operculum and no indication of a protruding exit papilla can be found on the mature sporangium. The zoöspores are about one fourth the size of the zoöspores of the host species of *Rhizophidium* (FIGS. 42 and 43).

The resting body is the most conspicuous phase of the life history of *S. Rhizophidii*. In the early stages of the epidemic caused by this parasite both zoösporangia and resting bodies can be found on the same sporangium of the host. By the end of the epidemic the majority of the host sporangia are covered by resting bodies of *S. Rhizophidii*. In its early stage of development the resting body is indistinguishable from a young sporangium. Elongation of the thallus indicates that it is to become a resting body. As the resting body matures, oil globules and protoplasm become concentrated in the distal end of the resting body. The proximal portion becomes vacuolated and finally empty of protoplasm as the cross wall forms (FIGS. 38 and 39). The large oil globules break up into numerous small oil globules, which are so compactly arranged as to give the contents of the resting body a homogenous appearance (FIG. 41). The stalk of the resting body is usually shorter than the portion containing the oil globules though it may be longer (FIG. 49). Germination of the resting bodies was not observed.

The zoöspores of the parasite develop only on immature zoösporangia of their host, *i.e.* sporangia in which the spores have not been cut out. Development of the host sporangium is stopped by the attack of the parasite although a large number of thalli may parasitize the *Rhizophidium* sporangium before complete disintegration of the host protoplasm is effected. It was not possible to obtain growth of the parasite apart from its host.

The host of *Septosperma Rhizophidii* is a saprophytic species of *Rhizophidium* which in the size and shape of the zoösporangia and the form of the exit papillae agrees well with Karling's (**5**) description of *R. macrosporum*. Most of the species of *Rhizophidium* are known as parasites of algae and oöspores of the Oömycetes and few species have been described as occurring saprophytically on such substrata as pollen and other plant parts. Identification of the species of *Rhizophidium* by the substratum or host on which it is found growing is complicated by the ability of some species of *Rhizophidium* as *R. carpophilum* to grow saprophytically on leaves and synthetic media and parasitically on the oöspores of *Achlya*. The host of *S. Rhizophidii* showed a remarkable tendency toward self parasitism. Attempts of the *Rhizophidium* zoöspores to germinate on a sporangium of their own species resulted in the immediate plasmolysis of the protoplasm of the sporangium (FIG. 51).

SUMMARY

Two parasitic chytrids, each constituting a new genus, were isolated from soil collections. Spore discharge by the dissolution of the sporangial wall is characteristic of the first genus, *Solutoparies*. The type species, *S. Pythii*, is parasitic on *Pythium*.

A new genus, *Septosperma*, is erected for *Phlyctidium anomalum* Couch and the second parasitic chytrid, *S. Rhizophidii*, both of which possess an elongated resting body, divided by a cross wall into an empty basal portion and an apical portion containing protoplasm and one or more oil globules. *Septosperma Rhizophidii* parasitizes *Rhizophidium*.

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EXPLANATION OF FIGURES

FIGS. 1–23. *Solutoparies Pythii.* Figs. 1–7. Stages in spore formation in zoösporangium, × 400. Fig. 1. 9:00 A.M., the sporangium has attained its mature size. Fig. 2. 3:00 P.M., vacuolization in base of rhizoid has begun prior to formation of wall cutting off the sporangium from the rhizoidal portion of the thallus. Fig. 3. 8:00 P.M., the rhizoids are cut off from the sporangium and the oil globules have become small and uniformly distributed in the protoplasm. Fig. 4. 9:00 A.M., the central vacuole has disappeared and numerous small vacuoles have appeared throughout the sporangium. Fig. 5. 1:00 P.M., the oil globules are beginning to aggregate. Fig. 6. 7:00 P.M., the oil globules are arranged in discrete groups. Fig. 7. 10:00 A.M., the oil globules have coalesced and the spores are cut out, each spore containing a single oil globule. Fig. 8. Two zoöspores showing eccentric position of the oil globule, × 860. Figs. 9 and 10. Stages in the germination of the zoöspore, × 560. Fig. 9. Zoöspore with germ tube. Fig. 10. Young germling with developing rhizoidal system (unless the rhizoids make contact with the host, development of the thallus does not go beyond this stage). Figs. 11–17. Spore discharge, × 350. Fig. 11. Mature sporangium. Fig. 12. The sporangial wall has begun to swell and to break. Fig. 13. Further dissolution of the wall. Fig. 14. Spines not yet dissolved. Fig. 15. The wall has completely disappeared and the spores

begin to free themselves from the gelatinous matrix in which they are imbedded. Fig. 16. The gelatinous matrix has disappeared and the spores are beginning to swim away. Fig. 17. The basal portion of the sporangial wall remains attached to the rhizoid. Fig. 18. Young thallus, grown on agar, showing the nature of the host-parasite relationship, × 350. Fig. 19. Surface view of zoösporangium, × 350. Figs. 20–23. Effect of the parasite on its host. Stages in increased branching of the host drawn from agar cultures, × 350. Fig. 20. 10:00 A.M., two germlings making contact with host hyphae. Fig. 21. 3:00 P.M., branching of the host about the parasite has begun. Fig. 22. 11:00 P.M., thalli of the parasite almost obscured by branching of the host. Fig. 23. 12:00 M., the upper parasite thallus of Fig. 22 just before being covered over by host hyphae.

FIGS. 25–31. Photomicrographs of *Solutoparies Pythii* and *Septosperma Rhizophidii*. Fig. 25. Tangled mass of branched *Pythium* hyphae on agar indicating the position of a thallus of *S. Pythii*, × 120. Fig. 26. Young thallus of *S. Pythii* on agar, × 430. Fig. 27. Mature thallus of *S. Pythii* on agar, × 450. Fig. 28. An unparasitized zoösporangium of *Rhizophidium* and one parasitized by *S. Rhizophidii*, × 150. Fig. 29. Resting bodies of *S. Rhizophidii*, × 750. Fig. 30. Zoösporangia and resting bodies of *S. Rhizophidii*, × 450. Fig. 31. Habit view of *S. Rhizophidii* and its host, *Rhizophidium macrosporum*, on a grass leaf, × 250.

FIGS. 33–52. *Septosperma Rhizophidii*. Fig. 33. Zoöspores germinating on host, × 850. Figs. 34 and 35. Two young thalli showing the nature of the haustorium, × 850. Fig. 36. Mature thallus of the parasite, × 850. Figs. 37–41. Stages in maturation of the resting body, × 600. Fig. 42. Zoöspore of host, *Rhizophidium*, × 850. Fig. 43. Zoöspores of the parasite, *S. Rhizophidii*, × 600. Fig. 44. Resting bodies on a disintegrating zoösporangium of host, × 850. Fig. 45. Detached zoösporangium of parasite, × 600. Fig. 46. Mature zoösporangia of the parasite on an immature zoösporangium of *Rhizophidium*, × 600. Fig. 47. Resting body with a short basal portion, × 850. Fig. 48. Zoösporangium of *Rhizophidium* with parasite in various stages of development, × 600. Fig. 49. Resting body with a long basal portion, × 850. Fig. 50. Habit sketch of the parasite on its host, × 530. Fig. 51. Zoöspores of *Rhizophidium* attacking a zoösporangium of *Rhizophidium* with plasmolysis as the evident result, × 300. Fig. 52. Mature zoösporangium of the host, *R. macrosporum*, × 300.

NOTES ON OKLAHOMA CERCOSPORAE—II

W. Winfield Ray

Recent collections of species of *Cercospora*, taken primarily in 1941, have been sent to Dr. C. D. Chupp for examination and identification. Among these specimens were discovered 4 new species and 16 species not heretofore recorded for Oklahoma. Previously, 5 new species of *Cercospora* were described by the writer and 12 species listed as occurring on various hosts.[1, 2]

The writer is indebted to Dr. Chupp for suggesting the names and the technical descriptions of the species herein described and for the identification of the 16 species listed.

The following names are proposed:

1. **Cercospora cocculicola** sp. nov.

Maculae suborbiculares vel angulares, 1–4 mm. diametro, atro rubro-brunneae et saepe marginibus latibus rubro-brunneis restrictae, interdum cum centribus cinereus; plerumque fungus hypophyllus sed interdum amphigenus; stromatis globosis et nigris, 15–40 μ diametro; plerumque fasciculis dense; conidiophoris dilute olivaceo-brunneis, in masse nigris, uniformis in coloris et latitudinis, parce septatis, raro ramosis, undulatis, tortuosis, vel 1–3 geniculatis, ad apices rotundatis vel conicis cum cicatricibus sporarum minutis, 2–3.5 × 15–90 μ; conidiis dilute subflavo-olivaceis, obclavato-cylindricis, conidiis longissimis distincte obclavatis, rectis vel curvatis, indistincte pluriseptatis, ad bases obconicis, ad apices rotundatis vel conicis, 2–3.5 × 20–100 μ.

Hab. in foliis *Cocculus carolinus* (L.) DC., Stillwater, Oklahoma.

Leaf lesions subcircular to angular, 1–4 mm. in diameter, dark reddish-brown and often surrounded with a wide irregular burnt-sienna margin, sometimes with a gray center; fruiting principally hypophyllous, but sometimes amphigenous; stromata globular and black, 15–40 μ in diameter; fascicles mostly dense; conidiophores pale olivaceous brown, rather dark in mass, color and width uniform, sparingly septate, rarely branched, undulate, tortuous or 1–3 geniculate, apices rounded to conic with a minute spore scar, 2–3.5

[1] Ray, W. W. A new *Cercospora* from Oklahoma. Mycologia **32**: 271. 1940.

[2] Ray, W. W. Notes on Oklahoma *Cercosporae*. Mycologia **33**: 174–177. 1941.

$\times$ 15–90 μ; conidia pale yellowish olivaceous, obclavato-cylindric, the longest ones being distinctly obclavate, straight or curved, indistinctly multiseptate, bases obconic, tips rounded to conic, 2–3.5 $\times$ 20–100 μ.

HABIT: On leaves of *Cocculus carolinus* (L.) DC. in Stillwater, Oklahoma, July 1941.

TYPE: In the herbarium of the Department of Plant Pathology, Cornell University, No. *29641*.

This fungus differs from *Cercospora Cocculi* Syd., which has conidia and conidiophores 3.5 to 6 μ in width. It is distinct also from any of the other species described on the *Menispermaceae*.

2. **Cercospora Kolkwitziae** sp. nov.

Maculae orbiculares vel irregulares, 0.5–12 mm. longitudo, saepe confluentae et grandes, sordide rubro-brunneae cum centribus caesiobrunneis vel cum 1-multis maculis albus; fungus amphigenus sed copiosier in inferiore superficie; stromatis solum cellis paucis, brunneis; fasciculis cum 2–20 conidiophoris; conidiophoris mediocriter atrobrunneis sed ad apices leviter pallidis et attenuatis, pluriseptatis, non-ramosis, rectis vel undulatis vel leniter geniculatis, cicatricibus sporarum mediocris ad apicibus subtruncatis, 3–4.5 $\times$ 40–300 μ; conidiis hyalinis, acicularis vel interdum obclavatis vel cylindricis, rectis vel curvatis, indistincte pluriseptatis, ad bases truncatis vel obconicis, ad apices subacutis, 1.5–3 $\times$ 20–150 μ.

Hab. in foliis *Kolkwitzia amabilis* Graebn., Stillwater, Oklahoma.

Leaf lesions circular to irregular, 0.5–12 mm. in length, often confluent and covering large areas, dull reddish-brown with greyish-brown center or with one or more white flecks in each brown area; fruiting amphigenous but more abundant on the lower leaf surface; stromata of only a few brown cells; fascicles 2–20 stalks; conidiophores medium dark brown but slightly paler and attenuate toward the tips, multiseptate, not branched, straight to undulate or mildly geniculate, medium spore scar at the subtruncate apex, 3–4.5 $\times$ 40–300 μ; conidia hyaline, acicular or sometimes obclavate to cylindric, straight to curved, indistinctly pluriseptate, truncate to obconic at the bases, tips subacute, 1.5–3 $\times$ 20–150 μ.

HABIT: On leaves of *Kolkwitzia amabilis* Graebn. in Stillwater, Oklahoma, Sept. 9, 1941. This species on the same host was collected also by Geo. W. Carver at Tuskegee, Alabama, Aug. 12, 1935.

TYPE: In the herbarium of the Department of Plant Pathology, Cornell University, No. *29624*.

This new species differs noticeably from *Cercospora Weigeliae* Ellis & Ev. in possessing longer and darker conidiophores.

3. **Cercospora Physocarpi** sp. nov.

Maculae suborbiculares vel angulares, 0.5–4 mm. diametro, crebro confluentae, rubro-brunneae, maculae antiquissimae raro cum centribus cinereus minibus; plerumque fungus hypophyllus; stromatis levis vel prope nullis; fasciculis plerumque cum 2–10 conidiophoris; conidiophoris dilute ad bases sed apices angustatis et dilutiore, parce septatis, leviter geniculatis, non-ramosis, prope rectis, cicatricibus sporarum mediocris ad apicibus subtruncatis, 3–5 × 30–150 μ; conidiis acicularis et hyalinis, indistincte pluriseptatis, ad bases truncatis, ad apices acutis, 2–3.5 × 25–75 μ.

Hab. in foliis *Physocarpus bracteatus* Rehd., Stillwater, Oklahoma.

Leaf lesions subcircular to angular, 0.5–4 mm. in diameter, frequently confluent, reddish-brown, oldest spots rarely with small gray centers; fruiting principally hypophyllous; stromata slight or almost none; fascicles mostly 2–10 stalks; conidiophores pale at the bases but paler and narrowed toward the tips, sparingly septate, slightly geniculate, not branched, almost straight, medium spore scar at subtruncate tips, 3–5 × 30–150 μ; conidia acicular and hyaline, indistinctly multiseptate, tips acute, bases truncate, 2–3.5 × 25–75 μ.

HABIT: On leaves of *Physocarpus bracteatus* Rehd. in Stillwater, Oklahoma, August 26, 1941.

TYPE: In the herbarium of the Department of Plant Pathology, Cornell University, No. *29639*.

Two species of *Cercospora* have been described as occurring on *Spiraea* with which *Physocarpus* has by some been made synonymous. The type of *C. Spiraeae* Thum. is a species of *Cercosporella* and *C. Rubigo* Cooke & Hark. is a species of *Cylindrosporium*.

4. **Cercospora Corylina** sp. nov.

Maculae suborbiculares vel angulares et irregulares, 1–12 mm. diametro, saepe confluentae, rubro-brunneae vel atro rubro-brunneae; fungus hypophyllus; stromatis solum cellis paucis, brunneis; fasciculis cum 2–8 conidiophoris; conidiophoris dilute vel mediocris brunneis sed ad apices angustatis et dilutiore, pluriseptatis, non-ramosis, 0–3 geniculatis, cicatricibus sporarum mediocris ad apicibus subtruncatis, 3–4.5 × 40–250 μ; conidiis hyalinis, acicularis, rectis vel curvatis, indistincte pluriseptatis, ad bases truncatis, ad apices acutis, 3–4.5 × 40–150 μ.

Hab. in foliis *Corylus rostrata* Ait., Stillwater, Oklahoma.

Leaf lesions subcircular to angular and irregular, 1–12 mm. in diameter, often confluent, reddish-brown to dark reddish-brown; fruiting hypophyllous; stromata only a few cells, brown; fascicles with 2–8 stalks, pale to medium brown but paler and narrowed toward the tip, multiseptate, not branched, 0–3 geniculate, medium brown spore scar at subtruncate tips, 3–4.5 × 40–250 μ; conidia hyaline, acicular, straight to curved, indistinctly multiseptate, bases truncate, tips acute, 3–4.5 × 40–150 μ.

HABIT: On leaves of *Corylus rostrata* Ait. and *C. americana* × *avellana* in Stillwater, Oklahoma, September 17, 1940.

TYPE: In the herbarium of the Department of Plant Pathology, Cornell University, No. *31434*.

The fungus, *Cercospora Coryli* Mont., differs from the species described above in having short conidiophores and colored, cylindric conidia.

The following species have been deposited in the Cryptogamic Herbarium at the Oklahoma A. and M. College:

5. *Cercospora adusta* Heald & Wolf.
   On *Ligustrum ovalifolium* Hassk., Stillwater, Aug. 8, 1941, No. *2222*.
6. *Cercospora Althaeina* Sacc.
   On *Althaea rosea* L., Stillwater, May 7, 1941, No. *2215*.
7. *Cercospora angulata* Winter.
   On *Philadelphus coronarius* L., Lawton, Oct. 19, 1940, No. *2282; P. grandiflorus* Willd., Stillwater, Aug. 21, 1941, No. *2227; P. Lemoinei* Lem., Stillwater, Sept. 18, 1941, No. *2208*.
8. *Cercospora avicularis* Winter.
   On *Polygonum pennsylvanicum* L., Stillwater, Sept. 17, 1941, No. *2231*.
9. *Cercospora Callicarpae* Cooke.
   On *Callicarpa americana* L., Poteau, Aug. 25, 1941, No. *2224*.
10. *Cercospora Catalpae* Winter.
    On *Catalpa bignonioides* Walt., Comanche, Oklahoma, Oct. 25, 1941, No. *2312*.
11. *Cercospora Davisii* Ellis & Ev.
    On *Melilotus alba* Desr., Stillwater, May 21, 1941, No. *2228; M. officinalis* (L.) Lam., Stillwater, May 20, 1941, No. *2212*.
12. *Cercospora desmodiicola* Atk.
    On *Desmodium canescens* (L.) DC., Stillwater, Oklahoma, Aug. 14, 1939, No. *863*.
13. *Cercospora Elaeagni* Heald & Wolf.
    On *Elaeagnus angustifolia* L., Stillwater, Aug. 30, 1941, No. *2210*.
14. *Cercospora granuliformis* Ellis & Holw.
    On *Viola papilionaceae* Pursh., Stillwater, July 25, 1941, No. *2218*.
15. *Cercospora lathyrina* Ellis & Ev.
    On *Lathyrus latifolius* L., Perkins, July 14, 1941, No. *2229*.

16. *Cercospora Pentstemonis* Ellis & Kellerm.
On *Pentstemon Cobaea* Nutt., Pawnee, Oklahoma, July 1941, No. *2214.*
17. *Cercospora Petersii* (Berk. & Curt.) Atk.
On *Smilax Bona-Nox* L., Ripley, Sept. 10, 1941, No. *2211.*
18. *Cercospora Pulcherrimae* Tharp.
On *Euphorbia marginata* Pursh., Lawton, Oklahoma, Oct. 1941, No. *2241.*
19. *Cercospora rosicola* Pass. (*Mycosphaerella rosicola* (Pass.) Davis.)
On *Rosa* sp. (Cult.), Stillwater, Aug. 26, 1941, No. *2225.*
20. *Cercospora Teucrii* Ellis & Kellerm.
On *Teucrium canadense* L., Stillwater, Sept. 1940, No. *2230.*

OKLAHOMA A. & M. COLLEGE,
STILLWATER.

FUNGI OF SOUTHERN CALIFORNIA. I

PAUL MARSHALL REA

(WITH 3 FIGURES)

Southern California is of interest mycologically for several reasons. Since it is the southwestern corner of the United States, a knowledge of its fungus flora is essential to a picture of the distribution of fungi in this country. Having all the life zones from Lower Sonoran to Transition, it produces cosmopolitan subtropical species as well as those of circumpolar distribution. A number of species described from here about forty years ago have not since been reported and will be of interest as they are re-collected and their validity determined.

This paper is planned as the first of a series on the mycoflora, especially the higher fungi, of this region.

BATTARREA PERS. 1801 [1]

This is a cosmopolitan genus, found in all continents, but with individual plants usually rare and widely dispersed. Seldom have collections from one region been adequate to show the range of variation, and most of the proposed species have been based on single plants or collections. It is generally agreed that many of these are synonyms, and Hollos (**6**) believed there is only one highly variable species, while Lloyd (**7**. 7: 1175) concluded that there are two, *B. phalloides* and *B. Digueti*. Others recognize at least one more but disagree about its taxonomy. Although these

[1] The writer is indebted to the Santa Barbara Museum of Natural History for the privilege of reporting on specimens of *Battarrea* in its herbarium, to Dr. F. J. Seaver for a photograph and a pinch of the gleba of the types of *B. Griffithsii* in the N. Y. Botanical Garden, to Mr. J. A. Stevenson for gleba and notes on dehiscence of specimens of the genus in the Lloyd herbarium, to Dr. A. H. Smith for the photograph and opportunity to study the Texas specimens of *B. Digueti* in the Univ. of Michigan herbarium, and to Miss E. E. Morse for criticisms and suggestions. The photomicrograph for figure 3 was made by Miss Florence Connolly of the Sansum Clinic, and the photograph for figure 2A by Mr. E. Z. Rett. Mrs. Rea made the drawing for figure 1 and has participated in all the field and laboratory work.

plants have been known in England since 1784 and in this country since the Oregon collection of the Wilkes Exploring Expedition, 1838–42 (**4**), the details of their structure have been little known until recently because the significant stages of development are hypogean and difficult of access.

The basis of this study, apart from comparative material, is a series of 25 specimens from southern California, including 5 from the coastal region near Santa Barbara and 18 from the Mojave desert about ninety miles to the east. It appears to include most if not all the described forms of *Battarrea*. It affords new information on the structure of the elaters, confirms *B. Digueti* as a valid species with *B. Griffithsii* as a synonym, and contributes to, but does not solve, the problem of the limits of variation in *B. phalloides*.

The characters of the genus, as now understood, are as follows:

Sporophores at first hypogean, enclosed in a universal veil or exoperidium which dehisces circumscissilely or apically, the basal portion persisting as a volval cup at the base of the stipe. Stipe clothed with scales, hollow, with a slender axial cord in the cavity, elongating rapidly to lift the endoperidium at its apex above the ground. Endoperidium convex above, concave below, dehiscing circumscissilely and shedding the upper half, or dehiscing by multiple pores with the upper half long persistent. Gleba pulverulent at maturity, comprising globose ornamented spores; elaters with annular or spiral thickenings; and capillitium of tubular threads or amorphous strands arising from the floor of the endoperidium and forming a spongy tissue. Basidia forming an elementary hymenium lining cavities or logettes, clavate, producing four spores apically on sterigmata, not persisting at maturity. As far as is now known, the presence of elaters distinguishes *Battarrea* from all other fungi.

The putative species, about 16, may be grouped as follows:

Dehiscence of both peridia circumscissile; elaters up to 80, rarely 100 μ long.....*B. phalloides* group
Dehiscence of exoperidium apical, of endoperidium by multiple pores; the longer elaters typically 100–200 + μ long.....*B. Digueti*

The *Battarrea phalloides* group.

The plants with circumscissile dehiscence assume two principal forms and the taxonomic problem is whether these represent two species or variations of one. The traditional distinctions are:

Plants of slender habit, with narrow scales on the stipe. Represented by *B. phalloides* (Dicks.) Pers. (the type species).

Plants usually more robust, with broad, ribbon-like scales. Represented by *B. Stevenii* (Libos.) Fr.

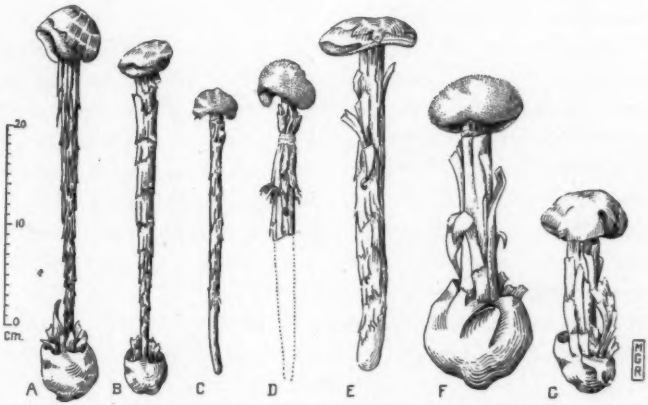

FIG. 1. Southern California specimens showing variation in the *Battarrea phalloides* group. Drawings were necessary because the specimens were not all available for photographing. *A, B,* specimens from the Mojave desert (Herb. Paul & Marian Rea *1011*). *C, D,* after photographs in Lloyd (7. 1: Aus.: pl. 28); *C* being Lloyd's fig. 1, a specimen collected in 1902 near Hueneme lighthouse, and *D* his fig. 2, a specimen collected in 1902 in the Santa Ynez Mts. *E,* specimen collected in 1939 by M. C. Richter in Mission Canyon, Santa Barbara (Rea *204*). *F,* after water-color sketch by Marian Rea of specimen collected in Jan., 1938, near Hendry's beach by Santa Barbara Mus. Nat. Hist., not preserved because of its strong odor. *G,* specimen collected in Oct. 1938, from same locality and probably from same mycelium as *F* (Herb. S. B. Mus. Nat. Hist.).

The bearing of our southern California plants on this question is sufficiently evident in figure 1 to require only a few supplementary observations. At one end of the series, some of the desert plants (FIG. 1 A) agree perfectly with the typical English *B. phalloides* in size, slender habit, fine scales, and other characters. At the other end, two plants from the coast (FIG. 1 F, G) agree equally well with *B. Stevenii.* All the 17 desert plants, taken at the same locality and date, have the slender habit, but some have broader scales (FIG. 1 B) and these two types of scales often intergrade on the same stipe. The remaining figures (1 C, D, E) are from

plants collected in or near Santa Barbara and show further intermediate variations. Our conclusion is that, however different in the extremes, this series intergrades, and *B. Stevenii* should become a synonym of *B. phalloides* insofar as concerns the characters under consideration.

This is not the end of the matter, however, for Maublanc & Malençon (**10**) have put it in a new light by maintaining that the important distinction is the presence of abundant gelatinous material within the universal veil in the egg stage of *B. phalloides* and its entire absence in the second form. They cite observations of the dry volva by previous authors in plants referred to *B. Stevenii*, which they consider identical with *B. Guicciardiniana*, on which their principal work was done. They admit the priority of the former name but, because the type specimen lacked the volva, so important in their view, they chose to use the name *B. Guicciardiniana* Ces. They interpret *B. Gaudichaudii* Mont. as very close, but distinct by reason of a difference in color of spores. They are of the opinion that most of the other described species will fall into one or the other of the two principal types of this group when they are better known. They cite Mattirolo, whose work we have not seen, as adopting the name *B. Gaudichaudii*, with *B. Stevenii* and *B. Guicciardiniana* as synonyms.

Furthermore, they maintain that *B. phalloides*, with the gelatinous volva, is confined to northern, cooler, more humid regions, which they outline; while the *B. Stevenii-Guicciardiniana-Gaudichaudii* group, with dry volva, is confined to southern, subtropical, hot, dry regions.

Cunningham (**3**) reports that only plants with a dry volva are found in Australia, and adopts the name *B. Stevenii*. Of the dry volva he says: "It is this feature alone which separates these two closely related species" (*B. phalloides* and *B. Stevenii*).

Whether this sole feature, if substantiated, would form an acceptable specific distinction may be debated, but it is certainly an awkward one because it seems to require observation of the egg stage before any specimen can be specifically determined. One aspect of our series is noteworthy in this connection, viz., that it is the plants from the coast, in a very mild and equable climate, that conform in a striking manner with the traditional characters

of *B. Stevenii,* while those from the Mojave desert are the ones that conform with the traditional characters of *B. phalloides.* The latter come up in summer after occasional rains that are followed by temperatures often much over 100° F. This difference in habitat appears to be diametrically opposed to the theory of Maublanc & Malençon.

Pending further information on this troublesome problem of the dry or gelatinous egg, we continue to interpret our specimens as variations of one species which we designate, for the present at least, as *B. phalloides.* If and when they prove not to be that species, the relative merits of *B. Stevenii, B. Guicciardiniana,* and *B. Gaudichaudii* may be debated.

Battarrea Digueti Pat. & Har. (**11**) 1896.
B. Griffithsii Und. apud White (**16**) 1901.
B. Digueti form *minor* Lloyd (**7. 7**: 1175) 1923.

The distinctive characters of this species are: apical dehiscence of the exoperidium, which consequently leaves no volval patch on the endoperidium; dehiscence of the endoperidium by multiple pores; and greater length of the elaters.

The marked difference in the method of dehiscence might afford a basis for erecting a new genus for this plant, but to do so would in our opinion obscure its identity with *Battarrea* in other respects, viz., gleba with similar spores, elaters, and capillitium, and endoperidium convex above and concave below, borne on the apex of a long stipe which is hollow, with an axial cord in the cavity, clothed externally with scales that vary from needle-like to ribbon-like as in the *B. phalloides* group, and provided with a volval cup at the base.

The type collection was made in "Basse-Californie," Mexico, and the authors clearly described and illustrated the dehiscence by multiple pores and noted the length of the elaters as 100–150 μ.

The next collection was made by David Griffiths in 1900, at Tucson, Arizona, and was distributed in part to the New York Botanical Garden, where it became the type of *B. Griffithsii* Und.; in part to Lloyd, who published it (**7. 1**: 90) erroneously as from New Mexico; and in part to Hollos (**6**: 40). The original de-

scription of *B. Griffithsii* is misleading in that it says of the endoperidium: "lower part flat, showing the line of dehiscence distinctly," and the accompanying illustration "Peridium showing method of dehiscence" is a pen drawing showing a circumscissile crack, and no pores. In 1906, Lloyd (7. 2: Tyl. 7) said of *B. Digueti:* "This plant differs from all other known species in the *persistent* peridium. It has been collected in Lower California and in Arizona and was described by Miss White as *Battarrea Griffithsii.*" But Lloyd did not at that time appreciate the significance of the multiple pores in *B. Digueti,* believing that circumscissile dehiscence was merely delayed, and his photographs of the types of *B. Digueti* and *B. Griffithsii* (l. c. pl. 75) are so taken that they show little if any sign of the pores. Hence, his synonymy of these two species is not conclusive. It requires evidence that the original description was inaccurate and that the plant actually has multiple pores. It is therefore a satisfaction to publish a photograph (FIG. 2 C) of the types of *B. Griffithsii* kindly furnished by Dr. Seaver. Although a part of the margin of one specimen has disintegrated, this is not to be confused with circumscissile dehiscence and both specimens clearly show multiple pores. On this evidence, *B. Griffithsii* Und. becomes a synonym of *B. Digueti* Pat. & Har., a reduction confirmed by our finding elaters up to 138 μ long in the types of the former.

In 1909, Lloyd (7. 3: L25: 3) reported "a number of fine specimens, every one with peridium attached, which is *the characteristic* of this species, if it has any" collected by Dr. F. E. Lloyd at Zacatecas, Mexico. Again Lloyd failed to mention multiple pores, but Mr. J. A. Stevenson writes that these are present, and in the gleba we find elaters 114 μ long.

In 1921, Ivan M. Johnston made two collections from the Gulf of California region of Mexico, which were reported and illustrated by Lloyd (7. 7: 1174–5, pl. 228, f. 2334–5). The photographs show multiple pores, and it was this collection that finally convinced Lloyd that there are two real species of *Battarrea.* He says: "The endoperidium remains entire at least in all specimens I have seen and dehisces as shown by these specimens (Fig. 2334) by small circular, irregular mouths. That the upper half does finally dehisce by a circular cleavage, or breaks irregularly, and

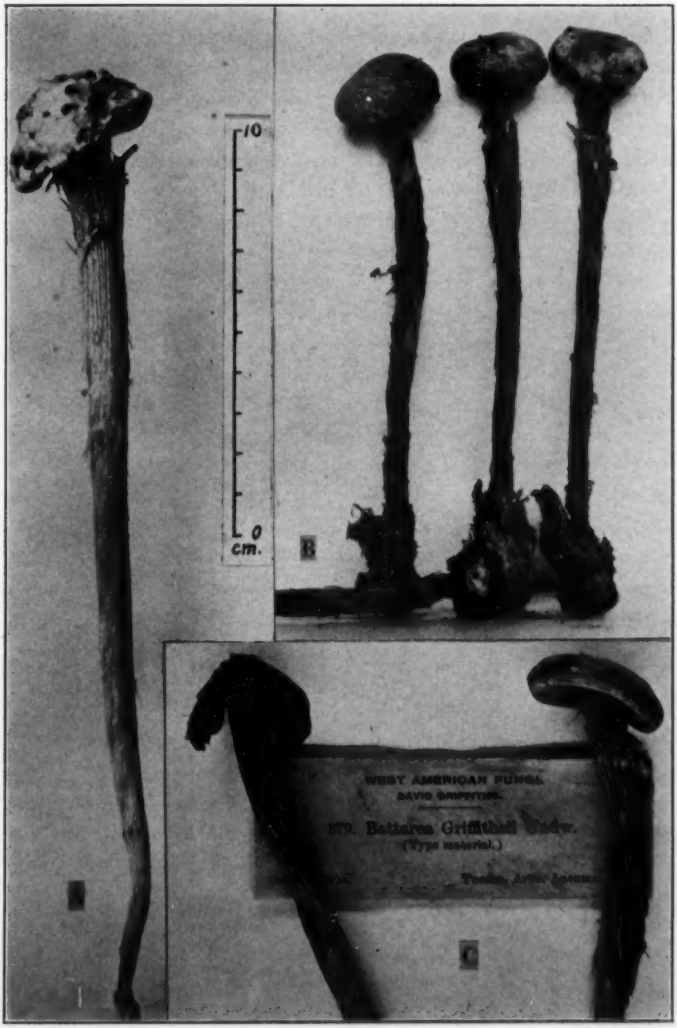

FIG. 2. *Battarrea Digueti* Pat. & Har.: *A*, from Mojave desert, California (Herb. Santa Barbara Mus. Nat. Hist.); *B*, from Hidalgo County, Texas (Herb. Univ. Mich.); *C*, from Tucson, Arizona (type of *B. Griffithsii* Und. in Herb. N. Y. Bot. Gard.).

falls away is probable, but I have no evidence of it on any specimen I have seen." One of the Johnston specimens, a slender plant but over 20 cm. tall, was described by Lloyd as form *minor* with the comment: "Surely the same plant as the previous but a small form." We find elaters up to 240 μ long in the larger specimen and up to 138 μ in the smaller, both with rather abundant branching.

In 1933, E. U. Clover collected in Hidalgo County, Texas, a very interesting series of four plants (FIG. 2 B), now in the herbarium of the University of Michigan. They are the smallest yet reported, show the pores well, and have elaters up to 156 μ long.

In 1938, on the edge of the Mojave desert about 17 miles from Palmdale, California, Mrs. Verna Wright collected a typical specimen (FIG. 2 A) but without the volva. This is in the herbarium of the Santa Barbara Museum of Natural History. It has the characteristic multiple pores and elaters up to 240 μ long, including several of the best examples of branching we have yet found (FIG. 3).

The validity of this species is established by the constant occurrence of multiple pores in a long-persistent endoperidium, and is strengthened by the presence in every collection of elaters exceeding in length any yet reported in other species.

THE GLEBA IN BATTARREA

It is generally agreed that the gleba is essentially the same in all plants of this genus. Little was known of its development until a locality was found in Tunis where the plants came up in quantity each year and Maublanc & Malençon (**10**) succeeded in obtaining all stages from eggs to maturity. Their investigation traced the early formation of cavities or logettes lined with basidia that mature in succession and produce apically four spores on sterigmata. Each basidium withers when it has discharged its spores, and after expansion of the plant no more basidia are formed. The basidia arise from interwoven hyphae of a subhymenium, the ultimate fate of which was not traced. Each logette has an outer wall of encircling hyphae which is said to persist as a delicate membrane around a cluster of spores. The tramal hyphae between the logettes arise from the floor of the endoperidium and persist as the capillitium of the mature gleba.

Mature capillitium. In some specimens this is in the form of very long threads up to 8 μ thick, tapering gradually to slender ends, rarely with short branches, tubular, with rather thick walls, rarely if ever septate. In other specimens the threads are degenerate, flattened, no longer showing a cavity, tending to fray out into vague filaments. Transitions between these two states are found.

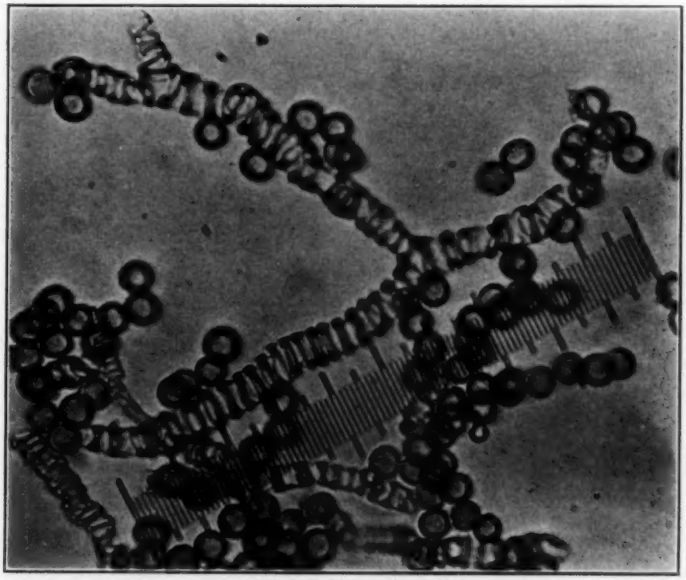

FIG. 3. Elaters in *Battarrea Digueti,* showing unusual length and branching. The micrometer scale is 120 μ long and its smallest divisions represent 1.2 μ.

Elaters. These peculiar elements of the gleba are very suggestive of the structures of the same name in the Hepatici and in the Myxomycetes (Trichiales). Their annular or spiral thickenings are internal, the delicate outer membrane being traceable over them. They have frequently been described as closed cells, but most of them are actually broken at one or both ends. They often have constrictions that suggest incipient breaks (FIG. 3, lower left), and in one instance an elater was seen to break as it moved in a

current of the mounting fluid. Elaters with short branches may be found occasionally in almost any specimen. These observations are a strong indication that the elaters of the mature gleba are fragments of a structure that was once more nearly continuous. Actual demonstration of this is found in *B. Digueti*. Not only do its elaters attain a length of 240 μ or more, but they sometimes show long and multiple branching. Figure 3 is a photomicrograph of an unusually fine example, yet even this complex structure is itself only a fragment, for three of the ends are broken (the fourth being hidden by spores).

The origin of the elaters is not known, but it is now evident that it must be sought in some extensive, branching tissue, and the time of formation has been fixed by Maublanc & Malençon (l. c.). They find that elaters appear among the spores suddenly and fully formed at about the time of expansion of the plant, while in slightly younger specimens they find no sign of them. They speculate that elaters correspond to degenerate spores produced by basidia at the moment when, impoverished by normal spore production, they are about to wither. While this might be a plausible hypothesis for the short fragments conceived as closed cells, it seems entirely inadequate for the extensive structures that are now the crux of the problem.

The most likely place to seek the origin of elaters is the subhymenium, which is the only tissue whose ultimate fate has not been traced. Here are hyphae of the requisite length and it is conceivable that, after production and withering of basidia has been completed, the substance of these hyphae may be used in forming annular and spiral thickenings of the walls. This would produce such long and complex elaters as we have found and, by fragmentation, the shorter pieces more commonly seen. It would explain the disappearance of the subhymenium as such, and the sudden emergence of elaters among the spores. Perhaps W. G. Smith (**13**) actually saw something of this process. He says: "The spiral thread within the vessel is clearly formed from a differentiation of the contents, as I have seen them in every stage. . . ." His figure illustrates these stages most interestingly. It differs from our own concept only in having the elaters produced as erect outgrowths from the subhymenium, while we think of

them as more probably a direct transformation of the horizontal hyphae themselves.

With respect to the reliability of the length of the longer elater fragments as a specific distinction, a few comments are in order. Our measurements for the *B. phalloides* group confirm those of previous authors, the maximum length in most specimens being 63–80 μ as reported by C. Rea (**12**: 53), very rarely up to 100 μ as reported by Hollos (**6**: 40). Every collection of *B. Digueti,* on the contrary, has them in excess of 100 μ, usually by a large margin. It is not at all impossible that some overlapping may be found by further search, but it is quite certain that the frequence of elaters over 100 μ long and the great length of some of them will prove a distinctive character of *B. Digueti.* If the elater is a little stronger in one species than in another it would explain why the length of the fragments is a specific character.

Spores. The spores are essentially the same in all specimens of *Battarrea* we have studied. They are globose, often apiculate, usually (4)5–6(7) μ in diameter. Giant spores of more irregular shape and up to 8.4×7.2 μ are rather common in one of Lloyd's *B. Digueti* from Zacatecas, and similar giants up to 9.6×7.2 μ in one of his *B. phalloides* from Santa Ana, California. The ornamentation is very much like that in *Ganoderma,* and has been variously interpreted as warted, reticulated, or perforate.

SANTA BARBARA, CALIFORNIA.

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MONILINIA AMELANCHIERIS

EDWIN E. HONEY

In a paper[1] giving brief preliminary notes on certain North American monilioid species of *Sclerotinia*, Reade (1908) described the conidial stage of a new species pathogenic on hosts designated by him as *Amelanchier canadensis* (L.) Medic. and *A. Botryapium* (L. F.) D C. collected during June of 1907 at Junus and Malloryville near Ithaca, New York. The perfect stage was not known to him, however, he designated it as "*Sclerotinia* (*Stromatinia*) *Amelanchieris* Reade n. f."

The purpose of the present note is to offer a brief technical description of the perfect stage together with the conidial stage as found by the writer in the above mentioned stations and neighboring localities in New York State pending the appearance of a more extended paper that has been prepared for publication.

The apothecial stage of Reade's *Monilia Amelanchieris* has been familiar to the writer since the spring of 1921 when on a collecting trip under the guidance of Professor H. H. Whetzel. For several subsequent springs collections of the apothecial and conidial stages of this fungus were made on trips taken in the vicinity of Ithaca, in the Finger Lakes Region of New York State. Brief reference has been made to this species in a previous paper.[2] In the present paper the writer includes this species within the genus *Monilinia* and describes for the first time the apothecial stage. Measurements used here are for fresh living material.

Monilinia Amelanchieris (Reade) comb. nov.[3]

Entostromata in dejectis perhiemantibus et mumificatis fructibus formata, quorum formam exteriorem nonnumquam subcuticula simulant, composita de

[1] Reade, J. M. *Sclerotinia* (*Stromatinia*) *Amelancheris* Reade n. sp. *In* Preliminary notes on some species of *Sclerotinia*. Ann. Myc. **6**: 114. 1908.

[2] Honey, E. E. North American species of *Monilinia* I. Occurrence, grouping, and life histories. Am. Jour. Bot. **23**: 101, 102, 105, 106. 1936.

[3] The writer wishes to acknowledge his indebtedness to Dr. J. P. Hieronimus of the University of Wisconsin for his generous assistance in translating the species diagnosis to Latin.

medullis densimuratis hyphalibus, quae plus minusve cum cellis hospitis necroticis collapsis intermixtae sunt, cortice nigro tecta, minus conspicua sed typo similia aliis generis speciebus; *spermatia* (microconidia) parva, 2.5–3.5 μ diam., sphaerica, plerumque maculam centralem refringentem habentia, fructibus mumificatis adjuncta qui entostromata habent, vel immediate vel spermatophoris (microconidiophoris) brevibus nascentia, in utrovis polo vel ambis simul ascosporarum quae in apotheciis veteribus manent, in myceliis vel in conidiis (macroconidiis), etiam in aquae vel aquaeductilis vel destillatae culturis inventa, in agari nutrienti abunde procreata; *apothecia* 1–3, plerumque 1, orientia parva aculeata fundamenta ab entostromatibus in parvis mumificatis fructibus, saepe ex fine florali sed interdum ex quovis loco fructus mumificati, adulta ad 4 cm. in altitudine, cyathoidea, pallida; *stipes* laevis et gracilis, cylindraceus, nonnihil inferne attenuatus, 1 mm. vel minus in latitudine, 3.5–4 cm. in longitudine, ex parallelis hyphis generi communibus compositus, superne disco concolor, inferne etiam atratior quam light seal brown (R.) [4] vel Van Dyke brown (R.); *discus* primo clausus, mox aperiens, expandens, postea cyathoideus vel infundibuliformis, 1.5–9 mm. diam., plerumque 4–5 mm., margo aliquantum crassus, colore varians ex cinnamon brown (R.) per Dresden brown (R.) and Snuff brown (R.) et Saccardo's umber (R.); *asci* cylindracei-clavati, 117.5–188.0 × 6–13 μ, plerumque 150 × 9 μ, cum apice rotundo incrassato qui poro perforatus est cuius claudens substantia iodo caerulescit, octospori; *ascosporae* saepe oblique et monostichis in parte superiore asci, ellispsoideae cum rotundis apicibus, hyalinae, continuae, lucidae, vel cum una macula refrigente ad untrumque sporae finem, 10–15.5 × 5.5–9.0 μ, plerumque 12–13 × 6.5–7.5 μ; *paraphyses* subabundantes, filiformes sed superne subclavatae, apice subapiculato potius quam rotundato, paulatim ad basem attenuatae, ex apice qui est 3.5–5.5 μ diam., plerumque sine ramulis, non septatae vel cum paucis septis saepe ad basem positis, hyalinae; *ectostromata* sub epidermide foliorum sparsorum, in floribus et fasciculis fructuum teneris enata, quibus ruptis effusa fructificatio conidialis efficitur, praesertim in regionibus necroticis in pagina superiore foliorum et calycis fructuum immaturorum, tegmen albescens vel cinereum et pulverulentum efficiens; *conidia* (*Monilia Amelanchieris* Reade) limoniformia, hyalina, continua, 14–23 × 10–14 μ, in longis dicho-vel trichotome ramosis catenulis, nascentia cum matura sunt, disjunctores, graciles et fusiformes, 2–3 μ longi, conidia intra catenulas dividunt.

HAB.: Apothecia nuntiantur in mumificatis perhiemantibus fructibus plantae palustris "shad bush," "Juneberry," vel "service berry" (*Amelanchier intermedia* Spach.), humi in foliis putrescentibus in locis humidis, mense Aprili exeunte et Maio ineunte; conidia nuntiantur pathogenica in *Amelanchieri intermedia* Spach., *Amelanchieri canadiensi* Med. (*Amelanchieri Botryapium* Borkh.), *Amelanchieri oblongifolia* Roem. et *Amelanchieris* spp., primo existens in hospitibus tempore florescentiae vel paulo post, deletor communis florum, fructum immaturorum, foliorum, et incrementi horni, mense Junio ineunte vel mediante, in regione Finger Lakes, New York.

[4] Ridgway, R. Color standards and color nomenclature, 44 pp. 53 col. pl. Washington, D. C. 1912.

Entostroma formed within fallen overwintered mummied fruits whose outer shape it may simulate more or less beneath the cuticle, composed of thick-walled hyphal medulla intermingled to varying degrees with the necrotic collapsed host cells, with a black protective rind; less conspicuous but of similar type to that of other species of the genus.

Spermatia (microconidia) small 2.5–3.5 μ in diameter, spherical, hyaline, commonly exhibiting a central refractive spot, associated with mummied fruits containing entostroma, produced at one or both poles of ascospores remaining in old apothecia, on conidia (macroconidia) or on mycelia directly or on single or clustered short flask-shaped spermatiophores (microconidiophores), also found in tap or distilled water and nutrient agar cultures.

Apothecia one to three, generally one, arising as small pointed fundaments from entostroma developed within small mummied fruits which may be scarcely more than in the late blossom stage up to medium sized fruits, commonly from the blossom end but may appear from any place on the mummied fruit, at maturity up to 4 cm. in height, cyathoid, light colored; *stipe* smooth, slender, cylindrical, tapering more or less below, up to 1 mm. in breadth, up to 3.5–4 cm. in length, composed of parallel hyphae typical of the genus, upper part of same color as the disc, base darker, even darker than Light Seal brown (R.) or Van Dyke brown (R.); *disc* at first closed, soon opening, expanding, becoming cyathoid, or somewhat infundibuliform, from 1.5 mm.-9 mm. in diameter averaging 4–5 mm., margin moderately thick, color somewhat variable from a cinnamon-brown (R.) through Dresden Brown (R.) to Snuff Brown (R.) and Saccardo's umber (R.). Asci cylindrical-clavate 117.5–188 $\times$ 6–13 μ, most averaging 150 $\times$ 9 μ, with a rounded thickened apex which is perforated by a pore, the closing substance of which stains blue with iodine, eight-spored; *ascospores,* commonly arranged obliquely-uniseriately in the upper end of the ascus, ellipsoidal with rounded ends, hyaline, continuous, clear or with a single refractive spot toward each end of the spore and measuring 10–15.5 $\times$ 5.5–9 μ, usually 12–13 $\times$ 6.5–7.5 μ; *paraphyses* moderately abundant, threadlike but slightly swollen toward the upper portion, the extreme tip inclined to be slightly pointed rather than rounded, gradually tapering from the tip which is from 3.3–5.5 μ in diameter, usually unbranched, non-septate or with few septa frequently placed toward the base, hyaline.

Ectostroma developed beneath the epidermis of scattered leaves, in blossoms and young fruit clusters rupturing the same and giving rise to an effuse conidial fructification particularly on necrotic areas on the upper surface of leaves and on the calyx-cup of immature fruits, forming a whitish or ash-gray pulverulent coating.

Conidia (*Monilia Amelanchieris* Reade) limoniform, hyaline, continuous, 14–23 × 10–14 μ borne in long dicho- and trichotomously branched chains, at maturity slender fusiform disjunctors 2–3 μ long separate the conidia within the chains.

HOSTS: Apothecial stage reported on the mummied overwintered fruits of the swamp shad bush, Juneberry, or service berry, *Amelanchier intermedia* Spach., on the ground in the leaf mold in moist places during the last half of April and the first half of May. Conidial stage reported pathogenic on *Amelanchier intermedia* Spach., *A. canadensis* Med. (*A. Botryapium* Borkh.), *A. oblongifolia* Roem. and *Amelanchier* spp., first appearing upon the suscepts at the time of bloom or shortly after, common and destructive to the blossoms, young fruits, leaves, and current years growth, during the early and middle part of June in the Finger Lakes Region, of New York State.

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NOTES ON FUNGI PREVIOUSLY UNREPORTED FROM MISSOURI

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During 1941, many collections[1] of fungi were made by the author in certain parts of Missouri. Those which have been identified with certainty and which are new for the state are discussed here. Remarks are given about those of special interest or which varied somewhat from the descriptions; the others are listed at the end of the paper. Duplicates of most collections are in the Herbarium of the University of Missouri.

Cordyceps militaris Link. Well developed specimens were found on larvae of a moth of the family Notodontidae in grassy soil in the woods after about a week of intermittent rains. Columbia.

Leotia lubrica forma Stevensoni (Berk. & Br.) Mass. Specimens were found at various times from late September to late October usually in rather rocky soil in oak woods. In all cases the color of the specimens placed them in this form rather than in the species proper. Bagnell Dam, Salem, Mineola.

Cronartium Quercuum (Berk.) Miyabe. The telial stage has been reported by Maneval (The University of Missouri Studies **12** (3): 1–150. 1937.) on leaves of oaks in Missouri. The aecial stage was found twice in May on young saplings of *Pinus echinata* Mill. In both cases the sapling was almost entirely girdled. The aecial stage on this pine has also been reported by Arthur (Manual of the rusts in United States and Canada. 1934.) from Arkansas and Tennessee. Shannon County, Texas County.

Puccinia Violae (Schum.) DC. This rust was reported by the author (Plant Disease Reporter **25** (8): 225–229. 1941.) in 1941 to occur on *Hybanthus concolor* (Forster) Spreng. It was

[1] The collections were made possible by a grant from the University Research Council, University of Missouri.

found again on this host on plants growing in a certain area at Meramec State Park. The spore characters agreed with the description of the species; this confirms the earlier report that *H. concolor* is another host for *P. Violae*.

All plants in the colony of *H. concolor* were heavily infected. The lowermost leaves were almost yellow because of the severity of the attack; younger leaves were lightly infected, and the youngest leaves on the date of collection (May 24, 1941), as well as others formed later, remained free of the disease. By June 15, 1941, many infected leaves had fallen or had become withered and curled.

Not infrequently white aecia were found intermingled with the normal orange ones. Sometimes the aecia on one side of a cluster were orange and those composing the rest of the cluster were white. Spores from the white aecia measured the same and had the same markings as did those from orange aecia. Sullivan.

HYDNUM FULIGINEO-VIOLACEUM Kalch. In most characters these plants fitted Banker's (Mem. Torrey Club **12**: 99–194. 1906.) description of the species. They differed in the following points: presence of a red juice in young broken caps; lack of scaliness of the cap; absence of a radicating base; presence of a violet tint in the cap. Since Banker (Mycologia **5**: 12–17. 1913.) finally referred his collection to a new species, *Sarcodon radicatus* Banker, and since the Missouri plants agree with the description of *H. fuligineo-violaceum*, it seems likely that this collection represents Kalchbrenner's plants. Eminence.

CLAUDOPUS DEPLUENS Fries. In all respects but spore size and shape the specimens agreed with Kauffman's (The Agaricaceae of Michigan, 1918.) description. He lists the spores as "7–10 × 6–7.5 micr.," whereas these plants' spores were 8.5–10 μ and spherical. Eminence.

CLITOCYBE LACCATA var. STRIATULATA Peck. Two collections of this plant macroscopically fitted the description well. In one collection, however, the spores were 8.5–10 μ in diameter rather than 9–11, as Kauffman gives, and in the other collection the spores were noticeably smaller—6–7 μ in diameter. In spite of these differences the specimens could be referred only to *C. laccata*

var. *striatulata*. Common and widespread after rains. Winona, Kingdom City.

CLITOPILUS WOODIANUS Peck. Specimens of this species that Kauffman found to be rare in Michigan were found once on leaf mold after prolonged rain. Spores were $8.5 \times 7\mu$ rather than 7 micr. in diameter as Kauffman states. Winona.

COPRINUS PLICATILIS Fries. Found in two localities on dead grass leaves in woods. Spores were $12–15.5 \times 9–10.5\ \mu$, whereas Kauffman gives "$10–12 \times 7.5$ to $8.5 \times 5–6$ micr." Mineola.

CORTINARIUS MICHIGANENSIS Kauff. A number of specimens of varying stages of development were found in leaf mold and rocky soil in a small ravine in oak woods. The caps were not as large as Kauffman's plants (6 cm. wide as compared with 8–14 cm.) and the gills were not serratulate. The spores were slightly different from Kauffman's description: 8–9 (rarely 10) $\times$ 5–6 μ rather than $8–10.5 \times 4.5–5.5$ micr. In spite of these differences the specimens seemed best to fit this species. Bagnell Dam.

ECCILIA PENTAGONOSPORA Atk. A number of plants that best fitted the description of this species were found on soil in oak woods after several days of rainfall. The plants differed from Kauffman's plants in that the caps were browner than "steel-gray" and were not "appressed-scurfy." The spores were $8.5–10 \times 7–10\ \mu$, whereas Kauffman gives "7–9.5 micr." Winona.

LACTARIUS DELICIOSUS Fries. One collection of this species was made in pine-oak leaf mold after prolonged rainfall. Kauffman states that the taste is "mild" and Burlingham (N. Am. Flora 9: 162–426. 1910–1916.) states that it is "somewhat acrid," but these specimens were strongly acrid. In all other characters the plants were typical. One item not mentioned in the descriptions is that twisted, copper-orange hyphae measuring usually $60 \times 5\ \mu$ arose from a mass of copper-orange, coiled hyphae in the trama and pushed to the surface of the hymenium. Eminence.

LACTARIUS PERGAMENUS Fries. Two collections of this plant were made. They agreed well with the description except for the following: Burlingham gives the spore characteristics as "$6 \times 8\ \mu$, minutely echinulate," but the spores of these plants were smooth and measured in the two collections $7–8 \times 6–6.5\ \mu$ and $7.5–8.5 \times 5–6\ \mu$. Salem.

LEPIOTA CLYPEOLARIA Fries. Found twice on leaf mold in oak woods. The plants agreed well with Kauffman's plants except in regard to spore size. Kauffman gives "10–16 × 4–6 micr., very variable in size"; the Missouri plants were 12–15 × 5–7 μ. Mineola, Salem.

LEPTONIA SETICEPS Atk. Several specimens of this fungus were found on a decaying oak log in the woods. They were slightly different from Kauffman's description: caps were not over 1.5 cm. wide (Kauffman gives 1–3 cm.); stems were 3–4 cm. long (compared with 1–2 cm.); gill edge was not eroded: cystidia measured 37–60 × 15–30 μ (Kauffman states "50–60 × 10–15 micr."). Bagnell Dam.

OMPHALIA EPICHYSIUM Fries. Specimens best fitting this species were found on a decaying log in the woods. The plants were somewhat lighter in color than Kauffman states, and the spores measured 5–6 × 3.5 μ rather than 7 × 4 as in his description. Columbia.

PANAEOLUS RETIRUGIS Fries. The spores of the specimens were 12–14 × 7–8.5 μ as compared with Kauffman's measurement of "15–18 × 9–11 micr." On soil in a flower bed recently manured. Columbia.

PLEUROTUS CORTICATUS Fries. No sporophores of this fungus were found. However, from black-tipped coremia lining a cavity in the decayed heartwood of a black oak (*Quercus velutina* Lam.) and from rotted wood underlying the coremia pure cultures of a fungus were secured. After growing on a mixture of beech shavings and 4 per cent malt extract for over three months, the fungus produced small sporophores on the gills of which basidiospores developed. These spores measured 12–17 × 5–7 μ, were elliptical to oval, often narrowed at one end, obliquely, slightly apiculate, hyaline, smooth. Kaufert (Tech. Bull. **114**, U. of Minn. 1936.) reports the mean size of the spores as 16.05 ± 1.07 × 4.8 ± .222. He reports it from Louisiana and Mississippi from decay of young fire-scarred hardwoods and refers to its having been found in the eastern United States. The decay in the Missouri trees was associated with a partially healed branch stub. Willow Springs.

PSATHYRELLA CRENATA Fries. A number of specimens, with veil still present, were found on decaying wood and leaves in the woods. The spores were 12–13.5 × 7–7.5 μ as compared with Kauffman's measurement of "10–12.5 × 6–7 micr." The infrequent pleurocystidia were cylindrical, tapering slightly at both ends, and usually about 50 × 12 μ in size; no cheilocystidia were found. Columbia.

The following fungi new to the state were also collected and identified: *Humarina semiimmersa* (Karst.) Seaver. Columbia; *Patella albida* (Schaeff.) Seaver. Columbia; *P. pulcherrima* (Crouan) Seaver. Columbia; *Pilacre faginea* (Fries) Berk. & Br. Columbia; *Clavaria pistillaris* Fries. Miller County, Columbia; *C. byssisseda* Fries. Columbia; *Typhula phacorrhiza* Reichard ex Fries. Columbia; *Hydnum zonatum* (Batsch.) Karst. Salem; *Polyporus circinatus* Fries at base of *Pinus echinata* Mill. Eminence (Overholts reported this only from Wisconsin and Michigan in his monograph in 1915 (Washington Univ. Studies 3: 1–98. 1915.)); *Amanita bisporiger* Atk. Sullivan; *A. spissa* Fries. Columbia; *Amanitopsis volvata* Peck. Eminence; *Cantharellus infundibuliformis* Fries. Salem; *C. tubaeformis* Fries. Eminence, Columbia; *Hygrophorus conicus* Fries. Eminence, Salem, Kingdom City, Columbia; *Hypholoma sublateritium* Fries. Columbia; *Lactarius indigo* Schw. Salem, Eminence; *Lepiota naucina* Fries. Columbia; *Psathyra obtusata* Fries. Columbia; *Boletus albellus* Peck. Salem; *B. luridus* var. *erythropus* Fries. Eminence; *Geaster coronatus* (Schaeff.) Schroet. Salem; *G. fimbriatus* Fries. Columbia; *G. radicans* Berk. & Curt. Columbia; *Lycoperdon fuscum* Bonorden. Eminence; *Scleroderma flavidum* Ellis & Ev. Miller County; *S. geaster* Fries. Columbia; *Tylostoma simulans* Lloyd, well formed by (!) February 15, 1942. Camden County. Reported by Coker and Couch (The Gasteromycetes of the Eastern United States and Canada. 1928.) from Ohio, Texas, South Carolina, Florida, Alabama, Iowa and Kansas.

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COLUMBIA, MISSOURI.

A NEW GENUS AND NEW SPECIES OF BROWN-SPORED INOPERCULATE DISCOMYCETES FROM PANAMA

H. H. WHETZEL [1]

(WITH 5 FIGURES)

Under date of February 21, 1936, I received a letter from Dr. G. W. Martin of the State University of Iowa in which he says, "Under separate cover I am mailing you some living material of what I take to be a species of *Lambertella*. This developed on some debris collected on Ancon Hill, Balboa, Panama, July 20, 1935. It was put in a moist chamber here on October 28th and shortly thereafter this form began to appear, very sparingly, and only one or two discs at a time."

About a week later the specimen arrived but the already formed apothecia had all rotted away except for the long hair-like stipes on one or two of which the shrivelled receptacle still hung at their tips. The piece of rotten branch was placed in a moist chamber and during the following 6 weeks five or six apothecia developed from previously ungerminated sclerotia scattered over the surface of the substrate (FIG. 3). From these ascospore cultures were obtained which promptly produced the minute black sclerotia in abundance (FIG. 1), but no apothecia developed from them.

Under date of October 15, 1937, I received from Dr. Martin a second collection of what proved to be this same species, this time on pieces of bark taken in the Canal Zone about 2 miles east of Arraijan, August 13, 1937. From apothecia developed from sclerotia on the bark placed in a moist chamber a second isolate of this fungus was obtained. Again from none of the isolates which

[1] *Acknowledgments:* I am greatly indebted to Dr. G. W. Martin and R. F. Cain for sending me the specimens upon which this paper is based, also for critical reading of the manuscript. This investigation was largely financed by a grant from the Penrose Fund of the American Philosophical Society for which I am most grateful.

I made did apothecia develop, although sclerotia were produced abundantly on potato dextrose agar. However, on November 17, 1937, Dr. Martin sent me two isolates which he had made from the 1937 collection. These produced mature apothecia readily and abundantly in about 8 weeks from the date of planting from sclerotia grown on potato dextrose agar (FIG. 4). From these single ascospore isolates were obtained. They all proved to be self sterile but by cross spermatization among themselves and with isolates I had previously made from the 1935 collection, it was readily demonstrated that the fungus is heterothallic.

A comparison of this fungus with *Lambertella corni-maris* Höhnel, which at the time I had fruiting in artificial culture, showed clearly that Martin's fungus could not be referred to *Lambertella*. *Lambertella* forms a thin diffuse stroma both in its natural substrate (rotting fruits) as also on potato dextrose agar. It consists of a one-cell-thick dark brown rind surrounding a thin medulla composed of a much branched hyphal network in which are enmeshed the partially digested substrate cells (or agar). The medullary hyphae are thin-walled. The stroma is subcuticular in the natural substrata. Martin's fungus on the other hand produces its stromata in the form of characteristic minute sclerotia hemisphaerical in shape, and attached firmly to the surface of the wood, bark or agar on which they are formed. Their structure is essentially that of the sclerotia of *Botrytis* species of the *cinerea* type, *i.e.* a black rind surrounding a loosely interwoven mass of thin walled hyphae embedded in a hyaline gelatinous matrix. Moreover the apothecia of Martin's fungus are very different from those of species of *Lambertella*, the only character they have in common being the colored spores.

As the outstanding characters of this Panamanian discomycete are unlike those of any of the stromatic inoperculates with which I am acquainted, I am presenting it as a new species and the type of a new genus, under the following name:

Martinia gen. nov.

Apothecia arising one or more from minute hemisphaerical sclerotia on the surface of the substrate; *receptacle* thin, membranous, shallow saucer shaped, 2 mm. more or less in diam.; *hymenium*

olivaceous to smoky brown when spores are mature; *stipe* long slender, hair-like, brightly colored; *asci* minute, 8-spored; *spores* one-celled, ellipsoid, biguttulate, olive brown. Conidial stage wanting. The genus is named in honor of Dr. G. W. Martin, the collector.

Martinia panamaensis sp. nov.

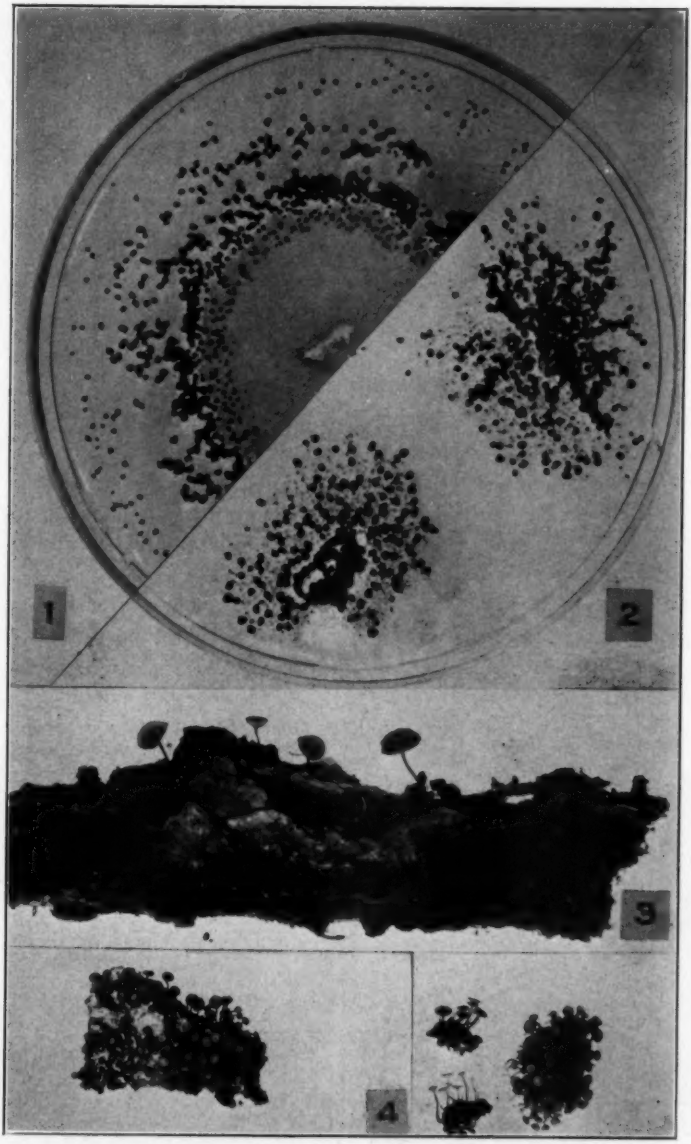
Stroma consisting of minute hemisphaerical black sclerotia 1–2 mm. in diam., scattered over and firmly attached to the surface of the substratum, singly or in small lobed aggregations; rind and medulla as in *Botrytis* of the *cinerea* type.

Spermatia known only in culture, globose about 2 μ in diameter, produced from the ends of Indian-club shaped spermatophores borne in naked fasciculate clusters (spermodochia) on the aerial mycelium. The species is heterothallic.

Apothecia one or two, sometimes more arising from each sclerotium, white, long stipitate, very small, 1–3 mm. diam., thin, membranous, fragile, shallow saucer shaped becoming flat expanded; *hymenium* just before spore discharge olivaceous brown becoming light yellow olive or ecru-olivė (R) immediately thereafter; *stipe* unusually long hair-like, reddish brown, lighter above; underside of cup and upper part of stipe coated with white pruinose to woolly hyphal tips; *asci* very small, cylindric above, attenuate below, base abruptly enlarged to form a foot, relatively broad, apex rounded and thickened, pore not sharply defined, J + (?), 50 meas. 32.5–48.0 $\times$ 4.2–5.9 μ, mode 39 $\times$ 5 μ, av. 40 $\times$ 5 μ; *ascospores* ellipsoid, slightly flattened on one side, one-celled, smooth, biguttulate, olivaceous or smoky brown when mature, 100 meas. 4–5 $\times$ 2–3 μ, mode 4.2 $\times$ 2.6 μ, av. 4.2 $\times$ 2.5 μ; *paraphyses* apparently simple but actually 2-branched near base, slender, scarcely enlarged toward the tip, not numerous.

On the surface of bark or wood of rotten logs and branches of trees of undetermined identity. Known from two collections, one at Ancon Hill near Balboa, Panama, July 20, 1935, the other near Arraijan, Canal Zone, August 13, 1937. In the case of both these

FIGS. 1–4. *Martinia panamaensis:* 1, zonate development of sclerotia on potato dextrose agar, nat. size; 2, two of four plantings in the same plate on potato dextrose agar, showing tendency of sclerotia to aggregate and coalesce, nat. size; 3, stick with apothecia developed from sclerotia on the bark in moist chamber, twice nat. size; 4, apothecia developed from sclerotia grown on potato dextrose agar; sclerotia with pieces of the agar cut out and placed on moist sand in a stender dish. Nat. size.



FIGS. 1–4.

collections apothecia were first detected on twigs or bark placed in moist chambers by Dr. Martin in his laboratory some months after the collections were made.

Herbarium material. Since our studies on this species were based chiefly on the 1937 collection this is made the type of the genus and of the species, Plant Path. Herb. Cornell Univ. No. *27040*. Duplicate material is also preserved in the Herb. Univ. Iowa, Martin's No. *4175*. The 1935 collection is deposited in the Plant Path. Herb. Cornell Univ. No. *25246*. Duplicate specimens of apothecia grown on potato dextrose agar from the type specimen have been distributed to the following herbaria: Farlow Herb., Harvard Univ.; New York Bot. Gard.; Royal Bot. Gard., Kew, Eng.; British Museum, London; Univ. Toronto, Canada; Mycol. Coll's. Bu. Pl. Ind., Washington, D. C.; Missouri Bot. Gard., St. Louis, Mo. and Univ. Museum, Ann Arbor, Mich.

Notes. The outstanding features of *Martinia panamaensis* are: (1) The unusually small asci and ascospores, compared with these organs in related genera having equally small apothecia while the spermatia are of the usual shape and size. (2) The combination of distinct sclerotia and colored ascospores. In the other brown spored genera of the stromatic inoperculates with which I am acquainted the apothecia arise from a diffuse or indeterminate stroma, while in *Martinia* the stromata are determinate, *i.e.* sclerotia.

The cultural characters of *M. panamaensis* on potato dextrose agar remind one of cultures of *Sclerotinia minor* Jaggar. The mycelium is white, forming a thin floccose cottony coating of aerial hyphae in which the bases of the jet black sclerotia are embedded. The sclerotia are, however, somewhat smaller than those of *S. minor* and are typically hemisphaerical in shape except when aggregated and fused as commonly occurs in artificial cultures. These lobed aggregates apparently result from the fusion of individual sclerotia, initials of which arise near one another. They are not to be regarded as single sclerotia. They are firmly attached by their flat bases to the surface of the agar in contrast to the loose superficial attachment of the sclerotia of *S. minor*. Sclerotia develop promptly on potato dextrose agar but apothecia require about 8 weeks from date of planting for their development and maturation. The individual isolated sclerotia usually give rise to

one apothecium, followed later by a second, and rarely by a third one.

In the report of fungi collected on the Mycological Foray at Duchesnay, Quebec, August 23–27, 1938 (Mycologia **31**: 736), R. F. Cain of the University of Toronto reported an unnamed species which he referred to *Phaeociboria*. My interest in that genus [2] at the time prompted me to write Cain for loan of his material. He very kindly sent me the specimen, saying in the accompanying letter of January 5, 1940, "I am very glad to send you the specimen which I called *Phaeociboria*. Unfortunately

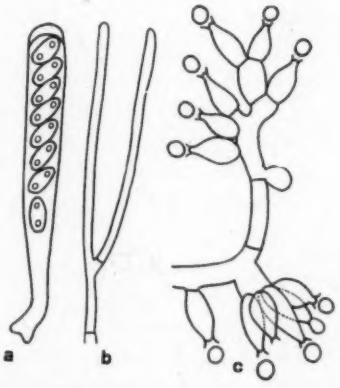


FIG. 5. *Martinia panamaensis: a*, ascus with mature ascospores; *b*, paraphysis; *c*, hyphal branch with two spermadochia in early stage of development. All figures × 1025.

there are only four apothecia and one of these I mounted in making the original examination. I am sending all the material and notes that I have. I must confess that I have no very sound reason for putting it in the genus *Phaeociboria*, except that it seemed to go there in elementary keys and there seems no other place for it. I hesitated to include the species in the list but it is so distinctive for a disco, and quite different from anything that I have ever seen before. You are entirely welcome to do whatever you think advisable with the material. You may be able to get a culture as

[2] See Mycologia **32**: 609–620. 1940.

the specimens have not been fumigated. I should have done this when it was fresh but did not get time."

The material Cain sent me consisted of a single ball of rabbit dung, collected along Pine River, Lac St. John, near Quebec City on August 25, 1938 (Cain's No. *6916*). On the dung ball placed in a moist chamber in the Botanical Laboratory in Toronto, apothecia developed November 1, 1938. The dung ball bearing 3 of the dried apothecia was glued to the lid of a pill box. Included in the package was a beautifully preserved slide of a fourth apothecium.

Following Cain's suggestion, dilution plates of ascospores from one of the dry apothecia were made in potato dextrose agar on February 2, 1940. The spores germinated 100 per cent (over a year after these apothecia had been dried!). The thalli developed from these ascospores on potato dextrose agar are strikingly like those of *Martinia panamaensis*, and the characters of the dried apothecia and ascospores are essentially identical with that species. However, no apothecia developed from the sclerotia of any of the several cultures thus obtained and which were presumably single spore isolates. Moreover repeated attempts to induce apothecial development by cross spermatization among these isolates and with the + and — isolates of *M. panamaensis* were also unsuccessful. I have, therefore, been unable to compare living apothecia of the Canadian form with those of the Panamanian form. The sclerotia of the former are consistently somewhat larger on the average than those of *M. panamaensis*. This, however, may not be of taxonomic significance and my failure to obtain apothecia by cross spermatization may well have been due to faulty technique.

At first thought the difference in substrata on which the two forms have been found might seem significant. This difference, however, is doubtless of little importance as both are obviously saprophytes, which probably thrive on a variety of dead plant debris, since both grow readily on potato dextrose agar. Their occurrence in such different geographic habitats is more difficult to rationalize. It is conceivable, of course, that the Canadian form may have developed from ascospores brought to the locality by migrating birds from Panama during the spring migration of 1938,

and that the Canadian collection does not represent a species persisting in this northern climate.

In view of the limited knowledge we have at present of this Canadian collection and because of the striking similarity of its morphological and cultural characters to those of the Panamanian specimens I can only assume that the two are specimens of the same species. Further studies on future collections may show them to be varieties or physiologic races of a widely distributed species ranging from the tropics to the cold temperate regions.

Cain's specimen is deposited in the Plant Path. Herb. at Cornell University under the No. *29646*.

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NOTES AND BRIEF ARTICLES

An extensive list of Institutions, Societies and Research Workers in the pure and applied plant sciences in C. and S. America has been prepared by the Editors of Chronica Botanica, in coöperation with the Div. of Agriculture of the Office of the Coordinator of Inter-American Affairs, Washington, D. C. It has been published in Chronica Botanica Vol. 7, no. 2 and 3 (March and May 1942).

Can We Reproduce Saccardo's Sylloge Fungorum?

The writer has recently found that, if advance subscriptions can be obtained from as few as fifty institutions or individuals, Saccardo's Sylloge Fungorum can be made available, in complete sets, at the very moderate cost of about $30 to $40 to each subscriber.

The process of reproduction, known as the Readex Microprint, furnishes actual printed pages that can be handled and used in much the same way as the pages of an ordinary book. This permits free and easy consultation of indexes, without the difficulties inherent in microfilm copies, and possibly with less wear and tear than occurs in the handling of actual books.

For the reading of the reproduction, a special patented apparatus is required. This apparatus throws the reduced printed page onto a glass screen at a convenient reading distance and at normal page size. It is already available in some institutions and is certain to become more generally available because of the use being made of it in historical research. Its cost at the present time is $225.00. This is but half the cost of a good microscope and, with the additional cost of the reproduction of the Sylloge, but a small fraction of what an original copy of the Sylloge would cost, if it were available at all. And to libraries a substantial discount is, of course, made from the price stated above.

If the reading apparatus were made available in the laboratories of research or teaching departments, it would be found adaptable to many uses other than that of reading microprint. With its

powerful surface illumination and magnification ranging around ten to sixteen diameters, it would supplant the hand lens and dissecting microscope for the superficial examination of minute fruiting bodies, small leaf spots and tiny lesions. With it, the areas of small lesions could be measured accurately, tracings and drawings could be made with ease, and the "scaling" of pathological samples could be done with increased accuracy and with decreased eye strain.

A microprint reproduction of the Sylloge would have many advantages. Individual sets could be made available at small cost to many research workers. Students in mycological courses could be given free access to the work, and libraries would be able to preserve original copies intact and undamaged for posterity.

The writer would be pleased to have the reaction of American mycologists to this proposed reproduction and would especially appreciate assurances that institutions or individuals would definitely subscribe for a microprint set of the Sylloge. It should be noted that a subscription for the reproduction does not entail the purchase simultaneously of the reading apparatus, although eventually subscribing institutions will undoubtedly obtain it for use with this and other reproduced reference works.—L. R. TEHON, 337 Natural Resources Building, Urbana, Illinois.

A NEW GENUS OF THE MYCETOZOA

Elaeomyxa gen. nov. (oily slime).

Peridiis distinctis, stipitatis vel sessilibus; calce absente; stipae, columello, sporangii muris, vel capillitio cera vel oleo munitis.

Sporangia distinct, stalked or sessile; sporangial wall membranous; capillitium consisting of branching and anastomosing, purplish threads; lime absent, replaced by inclusions, granules, or globules of an oily or waxy substance in the stalk, columella, sporangial wall, or capillitium.

The genus is proposed to include **Elaeomyxa cerifera** (G. Lister) Hagelstein, comb. nov. (*Diachea cerifera* G. Lister, Jour. Bot. **51**: 3. 1913.); and **Elaeomyxa miyazakiensis** (Emoto) Hagelstein, comb. nov. (*Diachea miyazakiensis* Emoto, Proc. Imp. Acad. Tokyo **11**: 444. 1935).

Type species: *Elaeomyxa miyazakiensis* (Emoto) Hagelstein.

The two forms are remarkable because of the presence of a waxy or oily substance which is unknown in any other species of the Mycetozoa. *E. cerifera* has this waxy material in the stalk, and in specimens from Japan, there is also a waxy collar at the apex of the stalk. European specimens do not have the collar, and may possibly represent another distinct species. Superficially, specimens of *E. cerifera* collected by Meylan in Switzerland, and by Brandza in Moldavia, resemble *Lamproderma columbinum* (Pers.) Rost., and Lister, in early references to the form, regarded it as a phase of that species. Meylan (Bull. Soc. Vaud. Sc. Nat. **58**: 82. 1933.) proposed its inclusion in the genus *Diacheopsis* which he had proposed earlier, although on other grounds than the waxy contents. *E. miyazakiensis* was described originally by Emoto as having oil granules in the sporangial wall, and in expansions of the capillitium. The latter species has been found repeatedly by Mr. Eli Davis near London, Ontario, on what appears to be decayed, black ash wood, although Mr. Davis is not certain about the identification of the wood. In specimens from there, the red oil-knots in the capillitium, and the red granules in the sporangial wall are numerous and prominent. *E. miyazakiensis* has some resemblance to a *Diachea,* but in that genus there are no expansions in the capillitium, and the included material is lime, and confined to the stalk and columella. Because of the scarcity of material, the true nature of the waxy or oily substance has not been confirmed by other investigators.

With two species now known, and having a common character not present otherwise in the Mycetozoa, it is proper they should be placed in a genus on this clear, generic character, rather than in any other genus with which they have only slight and indefinite affinities. The new genus, *Elaeomyxa,* cannot be placed satisfactorily in either of the calcareous families, nor in the Stemonitaceae, but must be regarded as constituting a distinct family, the Elaeomyxaceae.—ROBERT HAGELSTEIN.

FLORIDA RESUPINATE POLYPORES

The following is abstracted from a paper by the author on "Florida Polyporaceae" to appear in bulletin form. It is published here to obtain an earlier and wider circulation.

Hymenophore some shade of white, gray or yellow.
- Hymenophore annual ..... 1. *Poria*
- Hymenophore perennial; tubes white or pink ..... 2. *Perenniporia*

Hymenophore some shade of purple or red.
- Spores hyaline ..... 3. *Physisporinus*
- Spores fuscous ..... 4. *Meruliporia*

Hymenophore brown.
- Hymenophore annual.
  - Hymenium irpiciform ..... 5. *Hydnoporia*
  - Hymenium normally poroid.
    - Spores hyaline ..... 6. *Fuscoporia*
    - Spores brown ..... 7. *Fuscoporella*
- Hymenophore perennial.
  - Spores hyaline ..... 8. *Fomitiporia*
  - Spores brown ..... 9. *Fomitiporella*

Hymenophore black.
- Hymenophore annual ..... 10. *Tinctoporia*
- Hymenophore perennial ..... 11. *Melanoporia*

1. PORIA (Pers.) S. F. Gray

Represented in Florida by 23 described species.

2. **Perenniporia** gen. nov.

Hymenophore becoming perennial, rigid; context white or yellow; tubes pinkish, white or yellow, stratose in older specimens; spores hyaline.

Pileus resupinatus, perennis, induratus; contextu albo vel flavo; tubulis roseis, albis vel flavis, demum stratosis; sporis hyalinis.

P. unita (Pers.) Murrill; *P. nigrescens* (Bres.) Murrill.

3. PHYSISPORINUS P. Karst.

Represented in Florida by *P. spissus* (Schw.) Murrill and *P. vinctus* (Berk.) Murrill.

4. **Meruliporia** gen. nov.

Hymenophore resupinate, epixylous, effused, annual; pores merulioid, becoming purple to black with age; spores smooth, fuscous.

Pileus resupinatus, annuus; poris merulioideis, demum purpureis ad nigris; sporis levibus, fuscis.

M. incrassata (Berk. & Curt.) Murrill.

5–11. HYDNOPORIA–MELANOPORIA

These seven genera have already been treated in the author's publications.—W. A. MURRILL.

BOOK REVIEW

KARLING'S PLASMODIOPHORALES [1]

Professor Karling is to be congratulated on producing the first comprehensive treatise on the Plasmodiophorales to appear in America. It is to be hoped that this is but the beginning of a series which will illuminate the complex interrelationships and life cycles of the lower fungi.

The value of this text lies in the complete manner in which the widely scattered literature has been assembled and in the fair and unbiased manner in which the author has used the numerous, though often incomplete, contributions of the past to arrive at his conception of the group as it stands at present. As stated in the preface, the book is intended primarily for graduate and research students of mycology and the lower organisms. Let us hope, however, that teachers of mycology and plant pathology will now revise the first lecture of their courses and present a more comprehensive description of the group than has been customary in the past.

After a brief introduction Karling plunges into a detailed account of the cytology of the various species. This mode of presentation is to be commended because only by cytological studies is it possible to interpret the life cycles and pave the way for the treatment of

[1] Karling, J. S. Plasmodiophorales IX + 144 pages, 17 text-figures, 17 plates. Published by the Author, New York City, 1942.

sexuality and alternation of generations, which follows in Chapter III. After this come the detailed classification and descriptions of genera and species, dealt with in a conservative manner on the basis of information now available. This section also includes a full description of all doubtful or excluded species. Chapter V is devoted to questions of phylogeny and relationships with the Myxomycetes, Chytridiales, and Protozoa. It contains much information on other lower organisms with which mycologists ought to be more familiar and also an interesting historical account of the controversy concerning the systematic position of the Plasmodiophorales which has engaged the attention of mycologists and protozoölogists for half a century. The final chapter, a very long one, is devoted to club root of crucifers and powdery scab of potatoes. The questions of host specialization and methods of disease control are summarized into tables which should be particularly useful to pathologists.

On the whole I find very little to criticize in this volume. Although plant pathologists would doubtless have welcomed a few photographs of the host plants illustrating disease symptoms, all other phases of the work are adequately illustrated by text figures and numerous line drawings which cover 17 full page plates. A minor error occurs on page 1 where it is stated that all species except members of the genus *Ligniera* cause distortion of the host. *Polymyxa graminis* should be included here with *Ligniera*.

Since the author has endeavoured to stimulate further research on the many unsolved problems to be found in the Plasmodiophorales, the success of his book will best be registered by the rapidity with which a revised edition becomes essential. New species await the resourceful mycologist and even the known forms still present fruitful fields for cytological, morphological and physiological studies.—G. A. LEDINGHAM.

PARASITIC FUNGI OF WISCONSIN

There has recently come to hand a neat little book under the above title. This 157-page volume consists of a record of the parasitic fungi collected and compiled by Dr. J. J. Davis during his life-time. Since his death it has been prepared for the printers by

his colleagues and has been printed through the generosity of his daughter Margaret Davis. It is beautifully bound in board covers and stands out not only as a monument to its author, but a valuable list of the parasitic fungi of Wisconsin with an index both to the fungi and to the hosts on which they occur.

The writer is personally interested in this since it contains a record of *Sclerotinia Geranii* Seaver & Horne, the first record of this species to have been made outside of the type locality in the suburbs of New York City and still, we believe, the first record of the species outside of New York State. No doubt the list contains other equally important records.—F. J. SEAVER.

WHITE'S RUTSTROEMIA [1]

Having been long engaged in the study of the cup-fungi, the writer was naturally interested in reading a recent monograph by Dr. W. Lawrence White on the genus *Rutstroemia*. The title of this note is well worded for it is White's *Rutstroemia* and not Karsten's, since White passed over the first species of the genus, as established by Karsten, which would logically become the type, and in fact has been so designated, and selected, instead, the last of seven species on the list, *Peziza firma*, which had already been used by the writer as the type of the genus *Calycina* S. F. Gray.

In his attempt to justify this, White claims that the genus *Calycina* S. F. Gray, although established on *Peziza firma*, was untenable since the genus was proposed one year before Fries treated the cup-fungi in his Systema Mycologicum. Technically this would be correct were it not for the fact that an amendment to the rules is now pending before the International Commission on Nomenclature which would validate S. F. Gray's genera. Until this is acted on officially the throwing out of a genus on such a pretext is, in our opinion, unwarranted.

Another argument used against the writer's attempt to revive one of S. F. Gray's genera is the claim that Gray knew nothing about fungi, and had grouped together in this genus a number of species which are not now regarded as congeneric. This is no

[1] W. Lawrence White. A Monograph of the Genus Rutstroemia (Discomycetes). Lloydia **4**: 153–240. *75 figs.* 1941.

more true of S. F. Gray than it is of Karsten or of Fries himself, as has already been pointed out by the writer and others. This is necessarily true of any of the early workers since our concept of the genera is continually changing.

The type of Karsten's' *Rutstroemia* is *Peziza bulgarioides* Rab. (listed by White as one of the excluded species), a synonym of *Peziza strobilina* Fries, and a species which is fairly well known judging from the number of collections in our herbarium. Since this species belongs to an earlier Friesian genus, *Rutstroemia* becomes a straight synonym of that genus. This relegates *Rutstroemia* to synonymy where it should be allowed to remain. White's attempt to retain the name *Rutstroemia* while excluding the type species from the genus is a violation of the rule which reads (Section 2, Art. 18): *"The name of a group must be changed if the type of that name is excluded."*

From the above it will be seen that while White chides the writer for his so-called attempt to revive a genus founded by S. F. Gray in 1821, on the ground that it is pre-Friesian, he in his attempt to revamp the genus *Rutstroemia*, which had been abandoned by its own author, basing it on a species which even by stretching the rules to their limit could scarcely be regarded as the type, has, to put it plainly, "strained at a gnat and swallowed a camel." A pre-Friesian genus is no more invalid under the rules than a mistreated post-Friesian genus. The fact that it required ten pages of explanations to justify this procedure is evidence that the author realized that his disposition of the matter was highly irregular and would scarcely be accepted by coworkers in the group.

As to the genus itself, the limits seem to be so vague and indefinite that it is difficult even for a student of discomycetes to know whether a species does or does not belong to that genus. To use his own words: "Though the genus as here presented is considered a natural taxonomic unit, there is unfortunately from the practical viewpoint no one character which is infallibly common to all the species."

Although we are unable to accept White's version of the genus, he nevertheless deserves much commendation for the thorough work he has done on the various species treated. This is evident

from the large number of synonyms which he has brought together, by the fine illustrations used, and by the detailed study of the twenty species examined by him, which is equivalent to saying that his eggs are good but the basket in which they are placed is untenable. This can be rectified in a later treatment of the inoperculate cup-fungi.—FRED J. SEAVER, *Member of the International Commission for the Nomenclature of the Fungi.*